Toward a Sustainable Food System

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Summary

Agriculture uses more land and water than any other human activity. In just one human lifetime, world population has nearly quadrupled; and it may grow another 25% by the time today’s children reach middle age. Agriculture uses 40% of Earth’s total land area, yet the world now has 50% less farmland per capita than it did in 1960. We are working the land far more intensively, and straining land and water resources everywhere – including Wisconsin. Our consumption demands and production methods are devouring native prairies, rainforests, wetlands, fisheries, rivers, lakes and groundwater, and contributing to global warming.

Most of us now live in cities or suburbs, with no farms in sight. Our urbanized world depends on a vast food system for basic life support. In Wisconsin alone, we consume 30 million pounds of food every day. U.S. cities have just over a week’s supply of food on hand at any given time. Our food supply must be replenished every day of every year, for all generations to come.

The U.S. food system produces large volumes of food and farm commodities at low per unit cost. Industrialization and heavy chemical inputs produce high yields per acre. But our current system is also devouring farmers and the environment, and serving up large helpings of water pollution, greenhouse gas, waste and systemic risk. A more sustainable food system is possible, but real change will require serious thought and effort. All of us must do our part.

Agriculture is our nation’s biggest water polluter, and it accounts for over 10% of all U.S. greenhouse gas emissions. Thirty percent of our native U.S. topsoil – one of the planet’s most important natural resources – has already been lost to erosion. Lakes, streams, coastal areas and drinking water are widely contaminated by farm runoff. Intensive monoculture is replacing diverse farms, ecosystems and gene pools, and ramping up systemic risk. These environmental costs are not reflected in agribusiness balance sheets, or in the food prices we pay. Our food is costing us (and future generations) far more than we think. When we don’t count all the costs, it is easy to make bad choices.

The industrialization of agriculture has profoundly affected farm families and rural communities. Wisconsin lost half of its dairy farms in the last decade, even as state milk production (led by bigger, more industrialized farms) soared by 25%. Just 3% of U.S. farms account for nearly half of all farm revenue. U.S. farmers receive, on average, just 15 cents of every retail food dollar; and over half of all farm household income now comes from non-farm sources. Big food and agribusiness companies shape production practices and priorities, right down to the farm level.

Bankers look at a farm’s financial bottom line, not its conservation performance. There is constant pressure to increase farm output and cut per unit costs. Relentless supply chain cost-cutting rewards exploitive production, and discourages conservation. If we want a more sustainable food system, we need to provide different incentives to those who work the land.

Corn, our nation’s biggest cash crop, provides a stark example of our current food system priorities. Corn claims much of our nation’s richest farmland, and it is highly susceptible to erosion and runoff. It is also a voracious consumer of chemical inputs, including nitrogen fertilizer (a major water pollutant with a greenhouse gas footprint bigger than that of the airline industry). Today, only 10% of the U.S. corn crop goes directly to human food – mainly refined oils and sweeteners used in processed food and soft drinks (culprits in our nation’s obesity epidemic). A third of the entire crop now goes to feed U.S. cars (ethanol motor fuel). The rest – nearly 60% of the entire U.S. crop – goes for livestock feed here and abroad.
More concentrated dairy and livestock production, powered by more intensive feed production, is itself a major source of water pollution and greenhouse gas. A 1,000-cow dairy farm produces as much fecal waste as a city of 30,000 people. Today’s cows produce well over 2 pounds of manure for every pound of milk; so more cheese for our pizza means more manure concentration in our watersheds. Livestock operations also account for a third of all U.S. methane emissions.

Farm runoff is a major water pollution challenge. Wisconsin alone has 64,000 farms (including small hobby farms) covering 40% of the state’s land area. So even if runoff from some farms is modest, the collective impact on lakes, streams and groundwater is staggering. In many parts of the state, 20-30% of private wells exceed drinking water health limits for nitrate, which comes mainly from farm fertilizer and manure. Municipal water supplies are also affected. The costs to well owners and the public are large and growing. Farm runoff is harder to see and measure than pollution from a pipe, but it is every bit as real. Every farm is different, so there is no one-size-fits-all solution. Despite good efforts, current farm conservation programs barely scratch the surface.

More intensive commodity production has overwhelmed conventional conservation practices like conservation tillage and seasonal cover crops. Some big drivers include soaring world food and commodity demand, farmland loss, unmanaged U.S. commodity gluts, a big recent shift to high-input row crops like corn, heavy use of synthetic fertilizer and pesticides, more concentrated livestock production, reduced crop rotations, colossal food waste (the U.S. landfills a third of its total food supply), drainage systems that conduct pollution directly to lakes and streams, intensive irrigation that can deplete water resources and carry more pollution to groundwater, and larger storm runoff events associated with climate change. Conventional conservation practices are dwarfed – often on the same farm – by more intensive production overall.

Powerful forces are driving the U.S. food system down a hard and unsustainable path. But a gentler, more conservative approach is possible. Unlike many countries, which struggle to meet basic food needs, the U.S. produces far more food than we need for domestic consumption. That gives us some latitude to make different choices. We can provide more economic stability for farmers, protect our environment and quality of life, help feed the world, and reduce waste and systemic risk – all without undue national, global, business or personal sacrifice.

Farmers cannot, and should not, carry this burden alone. All of us, including consumers, food companies, farm service providers, financial institutions, local communities and government, have a stake in a sustainable food system. All of us must do our part. If we are serious about real change – not just “green washing” – here are some steps we can take:

- **Focus on our collective footprint.** People must eat, and our food system will always have a big environmental footprint. But our current trajectory is not sustainable. To change our trajectory, we must focus on big food system drivers – not just small-bore conservation practices. We must demand real accountability – starting with the big agribusiness and food companies that drive the system – and send the right economic signals to those who work the land. Consumers have a responsibility, too.

- **Reward conservation.** U.S. farmers currently receive just 15 cents of every retail food dollar. By returning just one more cent of each retail dollar to farms that meet robust conservation standards, the food and beverage industry could do much to protect our land and water, reward good conservation stewards, and stabilize our farm economy. Qualifying Wisconsin farms could get up to $100 per acre per year.
• **Focus on key markers.** Some key sustainability markers include farmland loss, pollution runoff, fertilizer and manure loading, greenhouse gas emissions, soil loss, and water pumping demand. We should pay more attention to cumulative trends, create strong conservation incentives, and measure *farm-wide* conservation performance.

• **Provide clear performance measures.** The U.S. already has some basic conservation standards for farms (NRCS 590). But we lack performance measures (speedometers) and farm-wide management targets (speed limits tied to rewards) for things like nitrate pollution and greenhouse gas emissions. These are within our reach, if we make the effort. Management targets can be tailored, to some degree, based on industry sectors and regional environmental conditions. Above all, farmers and the food industry need to *implement* the standards, which are now widely ignored. Clear standards and verified performance will provide a more credible foundation for "green" food production claims.

• **Internalize pollution costs.** Attractive conservation rewards and clear performance measures will make it more costly to pollute, because polluters will lose out on rewards. Farmers will still make their own decisions, but the calculus will change. We should ensure a level playing field by rewarding those who *already* operate sustainably, even as we provide incentives for others to improve. Incentives should be delivered in a systematic, predictable and user-friendly way, for maximum impact.

• **Reward continuing, farm-wide conservation performance.** The current system of one-time cost-share grants for isolated conservation practices is hopelessly inadequate. Conservation practices often stop when cost-share contracts expire, and benefits are often overwhelmed by more intensive production on the same farm (some cost-shared practices actually facilitate intensification). Cost-share contracts are cumbersome, and funding is meager. If we are serious about conservation, we must measure and reward continuing, *farm-wide* conservation performance – and we must do it at scale, in an efficient and user-friendly way. Computer apps, like Wisconsin’s *SnapPlus* app, can make it easier for farmers to evaluate and manage their farm’s overall conservation performance.

• **Let farmers manage.** Farmers know how to manage their farms to achieve operational goals. We should let farmers decide *how* to meet management performance targets that will qualify them for conservation rewards. Every farm is different, so there is no one-size-fits-all approach. Management performance should be rated on the basis of reliably projected, farm-wide results under normal conditions. Wisconsin’s *Snap Plus* Phosphorus Index offers a good example of how this can be done. We must acknowledge that actual results may vary to some degree, based on catastrophic storm events and other unpredictable contingencies over which farmers have no control.

• **Trust but verify.** We need a credible system for certifying conservation performance on farms that receive conservation rewards. Independent professionals can do much of this work, subject to reasonable government oversight. Conservation authorities should occasionally truth-check conservation performance claims (much like the IRS truth-checks self-certified tax returns). For that purpose, they should have reasonable access to relevant farm data, subject to privacy guaranties.

• **Pay close attention to big farms.** Big farms now produce most of our food, and that trend will continue. But more concentrated farms create more concentrated risk, requiring a higher level of management performance and accountability. We should make sure that highly concentrated livestock operations, in particular, meet strict standards for manure management and disposal. We should also ask ourselves whether some farms and food operations are becoming “too big to fail.”
• **Change farm subsidy programs.** The U.S. currently offers taxpayer-funded subsidies to compensate farmers for low market prices. But the current system does little to manage commodity gluts that drive farm prices down. Adjustments could help stabilize production and prices, stabilize farm income, and reward conservation. Farmers receiving federal subsidies should meet basic farm conservation standards (current NRCS 590). We should add rewards for farmers who meet higher farm-wide conservation standards.

• **Capitalize on new carbon trading and pollution mitigation markets.** Some greenhouse gas emitters and point-source water polluters can get mitigation credits by paying farmers to install offsetting conservation practices. This can be an important new source of funding for farm conservation. But these markets will not work if they require complex, case-by-case calculations and trades. There is also a danger in focusing on isolated practices to the exclusion of farm-wide performance. For example, a program might pay a farmer to plant a seasonal cover crop to sequester carbon in the soil; but if the farmer simultaneously plants more corn acres and applies more nitrogen fertilizer, the farm’s overall greenhouse gas footprint might actually increase. A proliferation of different trading standards and verification protocols may also lead to confusion, unfair competition and “green washing.”

• **Reduce food waste.** The U.S. should do its part to feed a hungry world, but not by destroying our nation’s land and water or accelerating global warming. We can reduce our environmental footprint and free up a lot of food for hungry people (including people right here in the U.S.), just by reducing food waste. The U.S. currently landfills over a third of its total food supply (household and retail waste). We should get serious, and achieve our stated national goal of reducing food waste by at least 50%.

• **Help Midwest farmers reduce their reliance on corn ethanol motor fuel mandates.** In a hungry world, it makes little sense to deplete the world’s best farmland to feed U.S. cars. Corn ethanol has a big environmental footprint, and its bio-energy output scarcely exceeds the fossil fuel inputs needed to produce it. Ethanol mandates have also fueled a speculative surge in farmland prices, which can hurt conservation and working farmers. As the U.S. transitions to electric vehicles, corn ethanol does not offer a sustainable future for farmers or the nation. We should provide farmers with viable alternative income streams that reward long-term resource conservation.

• **Foster farm service professionalism.** We should expect a high level of professionalism from farm service providers like crop consultants, input suppliers and manure haulers, who provide key advice and services to farmers. These service providers affect farm conservation in a big way, but they can have conflicts of interest.

• **Have a coordinated strategy.** Current U.S. policy often works at cross-purposes. We should coordinate farm policy with environmental policy. Farm conservation performance targets should be geared to meet ambitious but reasonably achievable environmental goals. Federal agencies should work with each other, and with state authorities and food producers, as a coordinated team. State personnel (including university extension agents and Wisconsin’s network of county conservation staff) can work directly with farmers and a more positively engaged food industry.

• **Restrain concentrated market power.** In recent decades, there has been a breathtaking concentration of power in our food system. We should systematically monitor, document and publicize these developments. We should also strengthen current antitrust laws, as needed, and take real action to restrain oligopoly power.

• **Think about our food choices.** Consumers can have a big impact on food system choices, by voting with their food dollars and supporting farm conservation efforts. Better consumer information can help.
Toward a Sustainable Food System

Most of us now live in cities or suburbs, with no farms in sight. Our urbanized world depends on a vast and complex food system for basic life support. In Wisconsin alone, we consume 30 million pounds of food every day.¹ U.S. cities have just over a week’s supply of food on hand at any given time.²

Our food supply must be replenished without fail, every day of every year, for all generations to come. That’s a big job – especially because the U.S. population has nearly tripled and world population has nearly quadrupled in just one lifetime.³ Despite declining birthrates, world population is expected to grow another 25% by 2050, when today's children reach middle age.⁴

Agriculture uses more land and water than any other human activity. Forty percent of world’s total land area is now devoted to agriculture (including production of commodities like coffee, cotton and corn ethanol), compared to just 7% in 1700.⁵ Agriculture is a major water polluter, and a major source of greenhouse gas emissions. Food and commodity production is straining land and water resources everywhere, including Wisconsin. Our consumption demands and production methods are devouring native prairies, rainforests, wetlands, fisheries, rivers, lakes and groundwater, and contributing to global warming.

Reducing this big footprint will not be easy. Consider nitrogen fertilizer, which was first synthesized in the early 1900’s. Synthetic nitrogen fertilizer has been called “The Detonator of the Population Explosion” because it smashed age-old nitrogen limits on food production.⁶ It now provides half of the world’s crop nitrogen, and half of the essential nitrogen in your body (think DNA, protein and basic cell functions).⁷ Without it, roughly 40% of the world’s population would not be alive today, and world food output would collapse.⁸

But nitrogen fertilizer is also a massive source of water pollution and greenhouse gas. Wisconsin uses roughly 350,000 tons of synthetic nitrogen fertilizer every year,⁹ and all of it is imported from outside the state. Crops take up only a fraction of the nitrogen applied to farm fields,¹⁰ so much of the applied nitrogen ends up as nitrous oxide (a hyper-potent greenhouse gas)¹¹ and nitrate runoff (a major water pollutant). Nitrate, leached mainly from nitrogen-enhanced farm fields, is Wisconsin’s most pervasive groundwater contaminant.¹² Nitrogen fertilizer manufacturing also has a huge carbon footprint,¹³ far exceeding that of the global airline industry.¹⁴
The U.S. applies 5 times more nitrogen fertilizer than it did in 1960.\textsuperscript{15} Wisconsin applications doubled in a single decade, from 2004-2014.\textsuperscript{16} More nitrogen fertilizer means, almost inevitably, more water pollution and greenhouse gas.

If current population, consumption and waste trends continue, the world will need to produce at least 50\% more food by the time today's children reach middle age.\textsuperscript{17} Yet the world has only half as much farmland per capita as it did in 1960.\textsuperscript{18} We have compensated by producing more food per acre, with heavy use of fertilizer, pesticides, high-yield genetics, specialized feed, antibiotics (agriculture accounts for 80\% of all U.S. antibiotic use),\textsuperscript{19} factory-style concentration, and intensive monoculture. All of this has environmental consequences.

Today, the U.S. produces 5 times more corn per acre than it did in 1950.\textsuperscript{20} We also produce 3 times more milk per cow.\textsuperscript{21} The old hen house may now contain a million birds, uniformly bred to meet processor specifications.\textsuperscript{22} With artificial insemination, a single prize bull can now sire over half a million calves.\textsuperscript{23} Crop and livestock gene pools have been rapidly transformed. Fencerow-to-fencerow monoculture has replaced natural biological diversity.
Farmers and consumers now depend on a global food system that includes integrated chemical and seed companies, genetics labs, meat and food processors, commodity traders, transportation networks, regional warehouse distributors, and retail grocery and restaurant chains (think Wal-Mart and McDonalds, for example). Food and agribusiness oligopolies wield great power, and shape food production practices and priorities right down to the farm level. U.S. farmers receive, on average, less than 15 cents of every food dollar spent by consumers (share varies by product).24

The pork industry is just one example of recent food system concentration. Just 4 companies now slaughter over 70% of all U.S. hogs;25 and just 2 companies (Smithfield, a Chinese company, and JBS, a Brazilian company) slaughter about 50% of all U.S. hogs.26 Plants that slaughter over a million hogs a year per plant now supply 95% of the U.S. pork market, compared to 27% in 1976.27 Just 100 vertically integrated farm operators (including major pork processors) now produce half of the nation’s hogs.28 Ninety percent of all U.S. hog farms disappeared in just 3 decades after 1980, as concentration and vertical integration swept the pork industry.29 Immigrant workers reportedly make up about 40% of the meat packing industry's overall workforce.30

Food production is an important pillar of Wisconsin's rural and urban economy. In Wisconsin, agriculture and wholesale food manufacturing account for over $100 billion in annual economic activity and 12% of state jobs (less than a quarter of that activity comes from farming per se).31 The dairy industry alone accounts for nearly half of that state total. Ninety percent of Wisconsin’s milk production goes for cheese (much of it for pizza and processed foods), and 90% of that cheese leaves the state.32 Wisconsin’s food industry relies heavily on livestock, and most of our farm revenue comes from milk, meat and livestock feed.33
Our industrialized food system excels at producing great quantities of food and farm commodities at low per-unit cost. The average U.S. family now spends just over 10% of its annual household budget on food, compared to 40% in 1900. But there are massive hidden costs that are not reflected in agribusiness balance sheets or consumer prices. Our food is costing us (and future generations) far more than we think. If we want a secure and sustainable food system, we had better pay attention.

The Crisis of U.S. Agriculture

Farmers Are Under Stress

The dramatic industrialization of agriculture has profoundly affected farm families and rural communities. Farm households now comprise less than 2% of Wisconsin’s population, compared to 30% just one lifetime ago. Wisconsin now has fewer than 7,000 dairy farms, compared to 140,000 in 1950. Yet we produce twice as much milk as we did in 1950.

Powerful economies of scale (including negotiating leverage and offloaded environmental costs) allow big farms to produce more food and feed at lower per-unit cost. So traditional farmers are under constant pressure to get big or get out. Just 3% of U.S. farms now account for nearly half of all farm revenue. In Wisconsin, as of 2007, just 13% of farm operators accounted for 76% of farm revenue and worked 46% of the state’s farmland. Absentee owners, including land speculators, now control a third of all Wisconsin farmland; so many farmers work rented land.

Dairy farms with over 1,000 cows now account for well over half of all U.S. milk production. Wisconsin lost half of its dairy farms in the last decade, even as state milk production – led by larger farms – soared by 25%. The average Wisconsin dairy farm now has about 186 cows (compared to 15 in 1950); but some Wisconsin dairy farms now have over 8,000 cows. Wisconsin still has 5 times more dairy farms than California (where the average dairy farm has well over 1,000 cows), but California produces 33% more milk.

Traditional family-supporting farms, once the backbone of the U.S. food system, have been declining (much like family-supporting factory jobs). On average, most farm household income now comes from nonfarm sources. More than half of the U.S. farmers who sell less than $350,000 a year are operating at a loss.
The average U.S. farmer is nearly 60 years old. Young people can still be farm workers, but few can now aspire to own a farm. Immigrant workers now account for at least 40% of Wisconsin’s dairy farm workforce. Rural communities built on traditional family farms are under stress.

Our food system, like our financial system, is now heavily exposed to a volatile world market. The U.S. exports roughly 20% of its total farm output, so the recent trade war with China devastated U.S. farm commodity demand and prices. A change in Chinese demand, a poor crop in Brazil, or a dairy surplus in New Zealand can have a big impact on commodity prices and land use decisions in Wisconsin.

The world food market, like the world financial market, is highly volatile. Although global demand has been growing over the long-term, commodity markets are prone to wild annual fluctuations and risk. Commodity traders may benefit, but farmers are riding an increasingly violent income roller coaster. Farm household income, even with crop insurance and price subsidy payments, is 8 times more volatile than non-farm household income. Like desperate gamblers in a big casino, farmers risk large financial investments on the next roll of the dice.

Farmers carry heavy debt loads for land, machinery, and farm inputs like seed, fertilizer and pesticides. Many try to increase revenue by working their land (often rented land) to its utmost capacity; but that can increase environmental damage. It can also contribute to system-wide production gluts that drive farm prices down. Excess system-wide production hurts farmers overall, but tends to benefit big food companies that want an ample supply of cheap farm commodities. Seed, fertilizer and chemical companies also benefit from all-out farm production.

The U.S. has largely dismantled Depression-era agricultural stabilization programs. In 1973, USDA Secretary Earl Butz famously urged U.S. farmers to plant “fencerow to fencerow;” and in 1996, the U.S. Freedom to Farm Act removed key production management mechanisms. The U.S. government has also curtailed counter-cyclical commodity purchases and sales that were once designed to buffer market swings (such programs are more difficult in a globalized market). Current programs offer taxpayer-funded subsidy payments to help offset the effect of price downturns; but they do little to manage production gluts that drive prices down. Most subsidy payments go to big farms, which account for most of the subsidized production.
Agriculture Is Our Biggest Water Polluter

Agriculture is our nation’s biggest water polluter, and the biggest polluter of Wisconsin lakes, streams and groundwater. Farm runoff from the Upper Midwest has created a vast “dead zone” in the Gulf of Mexico, and Wisconsin has its own “dead zone” in Green Bay. In Wisconsin, runoff comes from 64,000 farms (including small hobby farms) covering nearly 40% of the state’s land area. So even if runoff from some farms is modest, the collective impact is huge.

Important crop fertilizers, like nitrogen (N) and phosphorus (P), become bad water pollutants when they enter our water. In parts of Wisconsin, over 20% of private wells exceed state health standards for nitrate, leached mainly from nitrogen-enriched farm fields. Municipal wells are also affected. Nitrate contamination is linked to higher risk of thyroid disease, cancer and potentially fatal “blue baby” syndrome. Health care and drinking water remediation costs are large and growing.

Farm runoff, rich with nitrogen and phosphorus, is the primary cause of the stinking algae blooms that routinely choke our lakes and streams. Some algae blooms are toxic. In 2014, a toxic bloom caused by chronic farm runoff shut down the entire municipal water supply for Toledo, Ohio. Like Toledo, many Wisconsin cities including Milwaukee, Green Bay, Kenosha, Appleton and Oshkosh, get their drinking water from lakes or streams.
Each year, Wisconsin farmers apply a combined total of nearly half a million tons of concentrated nitrogen and phosphorus fertilizer – all of it imported from outside the state. 68 Each year our dairy industry also produces over 30 million tons of manure containing substantial amounts of nitrogen and phosphorus (much of which comes, ultimately, from synthetic feed supplements and fertilizer applied to feed crops). 69 Concentrated commercial fertilizer accounts for roughly two-thirds of the nitrogen and phosphorus applied to Wisconsin farmland, and dairy manure accounts for another third. 70 Much smaller (but locally significant) statewide nutrient loads come from poultry and other livestock manure, and from municipal waste that is treated for use as fertilizer. Much of this combined nutrient load eventually ends up in our lakes, streams and groundwater. 71

More concentrated livestock operations have created big manure disposal problems in some areas. 72 A 1,000-cow dairy farm creates as much fecal waste (total solids, BOD, nitrogen and phosphorus equivalents) as a city of 30,000 people (think Neenah, Stevens Point, Superior, Sun Prairie or West Bend). 73 Because manure is heavy with water, and expensive to haul, it tends to be over-applied near concentrated production sites. 74 In some parts of Wisconsin, soil and geologic conditions can allow direct manure runoff to groundwater. 75 Groundwater in those areas can easily be contaminated with manure pathogens as well as nutrients.
Wisconsin soil phosphorus levels have been rising for decades, as a result of fertilizer and manure applications. More phosphorus pollution is thus poised to enter our lakes and streams during soil erosion and runoff events. Phosphorus pollution is aggravated by soil erosion, because phosphorus readily adheres to soil particles.

![Mean Phosphorus Levels in Wisconsin Soils, 1974-2009](chart)

Chart based on UW-Madison Soil Testing Laboratories, *Wisconsin’s Historical 5-Year Summary Database.*

The federal Clean Water Act does not address pollution runoff from farms, although it does apply to livestock feedlots with more than 1,000 “animal units” (about 700 dairy cows). Farm runoff is hard to regulate because it occurs over millions of U.S. farms, and hundreds of millions of acres. It is strongly affected by weather, soils, topography, geology, irrigation and other conditions. It is harder to measure than pollution that comes out of a pipe, although it is every bit as real. Current efforts to control farm runoff are largely voluntary, and woefully underfunded. Despite some limited successes, we have been losing ground overall.

USDA has adopted basic minimum conservation standards for farms (NRCS 590), including standards for tolerable soil loss, nutrient management and runoff control. Wisconsin has adopted its own farm conservation standards, based largely on the USDA standards. But compliance with federal and state standards is largely voluntary, and there are huge compliance gaps. We need to improve the current standards, and create better farm-wide performance measures. Above all, we need to *implement* the standards in a broad-based and credible way.
**We Are Destroying Our Farmland Resource**

As President Franklin D. Roosevelt warned, "A nation that destroys its soils destroys itself." But we continue to send our soil down the river at an unsustainable rate, and in the process we are starving the future. By some estimates, the U.S. is losing an average of one inch of topsoil every 35 years. A third of our native topsoil may already be gone.

Soil erosion from farms is also a major source of water pollution. Of the billions of tons of soil lost from U.S. farms each year, up to 60% may end up in surface waters. Along with the sediment comes pollution from fertilizer, pesticides and manure. Farm runoff from the Upper Midwest is largely responsible for a Gulf of Mexico “dead zone” as big as New Jersey (2017).

Wisconsin’s erosion rate has increased by 25% since 1992, partly because of a heavy shift to erosive row crops like corn. This shift was part of a nationwide trend driven by global demand, but especially by corn ethanol motor fuel mandates. A third of all U.S. corn production now goes to feed U.S. cars.
In the Midwest, millions of acres have been shifted out of pasture and perennial vegetation, and into annual row crops like corn that require heavy chemical inputs and leave bare soil exposed to erosion for much of the year. Bigger storm events, possibly linked to global climate change, are making things worse. Climate change modeling suggests that Wisconsin soil erosion rates could double by 2050 without stronger action.

We are also converting much of our best farmland to concrete and suburban sprawl. Since 1980, development has destroyed enough good U.S. farmland to cover 70% of Wisconsin. In Wisconsin, over the same period, statewide development has destroyed enough good farmland to cover Dane County (see map).
Much of our very best farmland is located within easy commuting distance of urban areas, so it is under heavy development pressure. Land use conflicts are growing, as more industrialized farms collide with rapid suburban sprawl. As we convert farm fields to hard surfaces, we are also accelerating destructive storm runoff and flooding.

_Agriculture and Greenhouse Gas_

Agriculture accounts for over 10% of all U.S. greenhouse gas emissions, and 15% of Wisconsin emissions. That includes carbon dioxide from farm-related fossil fuel combustion, soil carbon released by annual row cropping, nitrous oxide from applied nitrogen fertilizer, and methane from ruminant livestock (like beef and dairy cattle). But the total is actually much _larger_ if we also count carbon emissions from fertilizer _manufacturing_.

According to a former chief of the USDA Soil Conservation Service, “Many activities in agriculture contribute to climate change, but the 800-pound gorilla that overpowers all of them is nitrogen.” Nitrogen fertilizer applications release nitrous oxide, which is 300 times more powerful than CO₂ as a greenhouse gas. But that is only part of the story. If we peek further upstream, we find that nitrogen fertilizer _manufacturing_ accounts for roughly 3% of total world CO₂ emissions – far more than the entire global airline industry.

Nitrogen fertilizer manufacturing accounts for at least 3% of world natural gas use, including _half of all natural gas use in Iowa_. (Iowa is home to at least 4 major nitrogen fertilizer manufacturing plants, some of very recent vintage.) The high-energy manufacturing process converts inert atmospheric nitrogen into chemical forms that can be used by crops (which, in turn, provide nutrient nitrogen to livestock and humans). Natural gas, used as both feedstock and fuel for the manufacturing process, accounts for 70 to 90% of the cost to manufacture nitrogen fertilizer.

The U.S., with 5% of the world's population, uses 12% of the world’s nitrogen fertilizer. The recent natural gas “fracking” boom sparked a corresponding boom in U.S. nitrogen fertilizer production, as companies built large new manufacturing plants to take advantage of cheap and plentiful gas. From 2015 to 2020, the U.S. increased its nitrogen fertilizer production by nearly 50%. So there is now a lot more nitrogen fertilizer looking for a market (annual supplies and prices may vary, based on natural gas supplies and prices).
Fertilizer costs money, so farmers have some incentive to conserve. But farmers also want to apply plenty of nutrients to ensure that crops grown on expensive farmland, from expensive seed, reach their full potential. When crop prices are high relative to nitrogen prices, farmers have an economic incentive to apply even more nitrogen. They also have an incentive to apply more nitrogen to irrigated crops, including those grown on sandy soils that are prone to nitrate leaching. Some crops, like corn and potatoes, are especially heavy nitrogen users. The recent heavy U.S. shift to corn production has been very good for nitrogen sales.

In the U.S., the manufacture and application of nitrogen fertilizer accounts for up to 75% of all greenhouse gas emissions related to crop production. Some food companies reportedly estimate that a third of their entire greenhouse gas footprint is attributable to nitrogen fertilizer used in their supply chains. Although nitrogen fertilizer is important for food production, we must use it far more judiciously if we want to reduce or limit agriculture’s greenhouse gas footprint.

As world population continues to grow, and more people demand diets higher in protein, agriculture’s greenhouse gas footprint will grow. By some estimates, food production alone could use up most of humanity’s greenhouse gas budget (the amount we can emit without exceeding global warming targets) by 2050. Diets high in animal protein, like the U.S. diet, entail higher overall greenhouse gas emissions. That is partly because of heavy methane emissions from ruminant livestock, but also because livestock-based diets require higher overall crop production (livestock need a lot of nutritious feed).

**There is Growing Systemic Risk**

In biology, as in finance, diversification is a hedge against risk. When we put all our eggs in one basket, we may be asking for trouble. But our food system is putting more and more “eggs” into fewer and fewer “baskets” – creating ever-larger systemic risks. Farms and food processing facilities are much larger and more geographically concentrated than ever before. Our food travels long distances from highly specialized production sites, and is delivered to highly dependent urban markets “just in time.” Farmers depend on giant oligopoly companies for critical farm inputs, processing, and market access. Big retail chains buy from a limited number of large, vertically integrated suppliers.

We have replaced diverse local farms and biological communities with highly concentrated livestock facilities and fencerow-to-fencerow monoculture. Much of our seed resource – the genetic foundation of our food system – is now privately owned and under tight oligopoly control (seeds are now treated as patentable inventions). Just 2 companies now produce roughly 70% of our corn and soybean seed (up from roughly 40% in 2004), and have patent controls over most of the seed produced by their competitors. Corn and soybean farmers no longer save their own seed from year to year. That is something new in the 10,000-year history of agriculture.

Critical pollinators are now endangered, and critical gene pools are threatened. Pesticide-resistant crop pests and antibiotic-resistant disease organisms are on the rise – a natural evolutionary response to heavy chemical and antibiotic use (agriculture accounts for 80% of all U.S. antibiotic use). Pests and disease can wreak havoc on dense, genetically uniform crops and livestock populations, and can move quickly through far-flung supply chains. Problems at a single, concentrated production site can have nationwide consequences.
In 2020, Covid-19 closures at just 8 giant processing facilities reportedly idled up to 40% of all U.S. pork processing capacity. Farmers, left without processing options, were faced with the prospect of euthanizing millions of hogs and disposing of their carcasses. President Trump, citing potential food shortages and supply chain disruptions, ordered meat plants to stay open despite Covid-19 risks to worker health.

In short, our food system has become a rather tense high wire act. The performance is stunning, but the risks are palpable. As in a nuclear power plant, a myriad of complex processes must work to perfection at all times; and some operations may now be "too big to fail."

**We Are Wasting Food and Resources**

Land and water resources are embodied in every agricultural commodity that we produce. For example, it takes roughly 2,500 gallons of water, 250 square feet of good farmland, and a pound of nitrogen (plant uptake from soil and fertilizer) to produce one bushel of corn with current methods. With every bushel that we produce, we incur hidden costs in the form of water pollution, soil loss and greenhouse gas emissions. The more we produce, consume and waste, the more pressure we put on our land, water, climate and environment. Our collective impact is enormous.

People need to eat, and food production will always have environmental costs. But are we making the right choices and striking the right balance? Is the market making the right choices for us, if it fails to account for large and growing environmental and climate change costs? Are we squandering resources that are important for the wellbeing of our society, and for our children's future?

Artificially cheap food commodities encourage overconsumption and resource waste. Forty percent of the U.S. population is obese, and we waste a third of our total food supply at the retail and household level. The U.S. landfills about 30 million tons of food every year – enough to feed all of Wisconsin for 5 years (food weight equivalent). Meanwhile, nearly 15% of U.S. households suffer from food insecurity. When we waste food, we waste scarce land and water resources and aggravate global warming.
Corn, our nation’s largest cash crop, provides a stark illustration of our current food system priorities:

- **Only 10% of the U.S. corn crop goes directly for human food.** Most of this goes for refined oils and sweeteners used in processed food and soft drinks (culprits in our national obesity epidemic). The sweet corn that we enjoy in fresh, frozen or canned form is just a small specialty crop that accounts for less than 1% of all U.S. corn production.

- **A third of the entire U.S. corn crop goes to feed U.S. cars and SUVs.** Corn ethanol now provides 10% of the total U.S. motor fuel supply, thanks to federal motor fuel blending mandates. But much of corn ethanol’s energy content is offset by the fossil energy needed to produce, transport and process the corn feedstock.

- **Nearly 60% of the U.S. corn crop goes for livestock feed.** Corn is an important feed crop because it provides a lot of feed Calories per acre (far more than perennial pasture), and is easily stored and transported to concentrated animal feedlots. An ample supply of corn has fueled the growth and concentration of the U.S. dairy and livestock industries, including Wisconsin’s cheese industry. Nearly all of the corn that we ship to other countries (about 20% of our total crop) also goes for livestock feed.

Soft drink sweeteners, ethanol motor fuel, and livestock feed are not exactly wasted uses of corn; but they have big environmental footprints. So we should think carefully about our consumption choices and national policies. For example, in today’s hungry world, does it make sense to deplete the world’s best farmland in order to feed fuel-guzzling U.S. cars and SUV’s?

**A Path Forward?**

Our food system faces daunting challenges. Farmers are under stress, and we are rapidly devouring the environment that sustains us. We are concentrating market power, and ramping up systemic risk.

Our current approach to farm conservation has barely scratched the surface. Despite some limited successes, farm runoff remains a huge and growing problem. Big production changes have overwhelmed modest farm conservation practices like conservation tillage and seasonal cover crops. Incremental conservation practices are dwarfed – often on the same farm – by more intensive production overall. Some big drivers include:

- Soaring world population and farm commodity demand.
- More intensive use of a dwindling farmland base.
- Unmanaged U.S. production gluts.
- A big shift from perennial vegetation to annual row crops like corn (partly driven by ethanol mandates).
- More use of nitrogen and phosphorus fertilizer (partly driven by ethanol mandates).
- More concentrated livestock and manure production.
- Colossal food waste (the U.S. landfills a third of its total food supply).
- More extensive drainage and irrigation, which can aggravate pollution runoff.
- Larger runoff events associated with climate change.
To date, farm conservation programs have not addressed greenhouse gas emissions related to agriculture. We have experimented with carbon sequestration schemes, without tackling more fundamental issues. As a former chief of the USDA Soil Conservation Service has said, "Many activities in agriculture contribute to climate change, but the 800-pound gorilla that overpowers all of them is nitrogen." Methane from livestock and carbon release from annual row cropping are also important concerns.

Sometimes it can feel like we are in a worldwide race to the bottom. But the U.S. situation is not hopeless. Indeed, it may offer significant opportunities. Unlike many countries, which struggle to meet basic food needs, the U.S. is blessed with enormous food production capacity. We produce far more food and farm commodities than we need for domestic consumption. That gives us some latitude to make different choices. We can provide more economic stability and options for farmers, protect our environment and quality of life, help feed the world, and reduce waste and systemic risk – all without undue national, global, business or personal sacrifice.

The U.S. should do its part to feed the world, but not by devouring the land and water resources on which our nation’s future depends. We can make a lot more food available to hungry people (including many in our own country) just by making better choices and curbing our own wasteful habits. We can also improve market performance, and reduce resource waste, by ensuring that commodity prices more adequately reflect environmental costs of production. U.S. policy should:

- Help to stabilize – not destabilize – farm production and prices.
- Internalize social and environmental costs that are ignored by current markets.
- Protect our land and water resources, now and for future generations.
- Reduce greenhouse gas emissions from agriculture, including large emissions from the application and manufacture of nitrogen fertilizer.
- Help farmers make a decent living and be good conservation stewards.
- Make it easier to do the right thing, and harder to do the wrong thing.
- Provide real help, but demand accountability.

Farmers cannot, and should not, carry this burden alone. All of us, including consumers, food companies, farm service providers, financial institutions, local communities and government, have a stake in a sustainable food system. All of us must do our part. If we are serious about real change – not just "green washing" – here are some steps we can take:

- **Focus on our collective footprint.** People must eat, and our food system will always have a big environmental footprint. But our current trajectory is not sustainable. To change our trajectory, we must focus on big food system drivers – not just small-bore conservation practices. We must demand real accountability – starting with the big agribusiness and food companies that drive the system – and send the right economic signals to those who work the land. Consumers have a responsibility, too.

- **Reward conservation.** U.S. farmers currently receive just 15 cents of every retail food dollar. By returning just one more cent of each retail dollar to farms that meet robust conservation standards, the food and beverage industry could do much to protect our land and water, reward good conservation stewards, and stabilize our farm economy. Qualifying Wisconsin farms could get up to $100 per acre per year.141
• **Focus on key markers.** Some key sustainability markers include farmland loss, pollution runoff, fertilizer and manure loading, greenhouse gas emissions, soil loss, and water pumping demand. We should pay more attention to cumulative trends, create strong conservation incentives, and measure farm-wide conservation performance.

• **Provide clear performance measures.** The U.S. already has some basic conservation standards for farms (NRCS 590). But we lack performance measures (speedometers) and farm-wide management targets (speed limits tied to rewards) for things like nitrate pollution and greenhouse gas emissions. These are within our reach, if we make the effort. Management targets can be tailored, to some degree, based on industry sectors and regional environmental conditions. Above all, farmers and the food industry need to implement farm conservation standards, which are now widely ignored. Clear standards and verified performance will provide a more credible foundation for “green” food production claims.

• **Internalize pollution costs.** Attractive conservation rewards and clear performance measures will make it more costly to pollute, because polluters will lose out on rewards. Farmers will still make their own decisions, but the calculus will change. We should ensure a level playing field by rewarding those who already operate sustainably, even as we provide incentives for others to improve. Incentives should be delivered in a systematic, predictable and user-friendly way, for maximum impact.

• **Reward continuing, farm-wide conservation performance.** The current system of one-time cost-share grants for isolated conservation practices is hopelessly inadequate. Conservation practices often stop when cost-share contracts expire, and benefits are often overwhelmed by more intensive production on the same farm (some cost-shared practices actually facilitate that intensification). Cost-share contracts are cumbersome, and funding is meager. If we are serious about conservation, we must measure and reward continuing, farm-wide conservation performance – and we must do it at scale, in an efficient and user-friendly way. Computer apps, like Wisconsin’s SnapPlus app, can make it easier for farmers to evaluate and manage their farm’s overall conservation performance.

• **Let farmers manage.** Farmers know how to manage their farms to achieve operational goals. We should let farmers decide how to meet management performance targets that will qualify them for conservation rewards. Every farm is different, so there is no one-size-fits-all approach. Management performance should be judged on the basis of reliably projected, farm-wide results under normal conditions. Wisconsin’s Snap Plus Phosphorus Index offers a good example of how this can be done. We must acknowledge that actual results may vary to some degree, based catastrophic storm events and other unpredictable contingencies over which farmers have no control.

• **Trust but verify.** We need a credible system for certifying conservation performance on farms that receive conservation rewards. Independent professionals can do much of this work, subject to reasonable government oversight. Conservation authorities should occasionally truth-check conservation performance claims (much like the IRS truth-checks self-certified tax returns). For that purpose, they should have reasonable access to relevant farm data, subject to privacy guaranties.

• **Pay close attention to big farms.** Big farms now produce most of our food, and that trend will continue. But more concentrated farms create more concentrated risk, requiring a higher level of management performance and accountability. Insurance providers are beginning to take risk concentration into account, when setting risk premiums. We should make sure that highly concentrated livestock operations, in particular, meet strict standards for manure management and disposal.\(^{142}\) We should also ask ourselves whether some farms and food operations are becoming “too big to fail.”

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• **Change farm subsidy programs.** The U.S. currently offers taxpayer-funded subsidies to compensate farmers for low market prices. But the current system does little to manage commodity gluts that drive farm prices down. Adjustments could help stabilize production and prices, stabilize farm income, and reward conservation. Farmers receiving federal subsidies should meet basic farm conservation standards (current NRCS 590). We should add rewards for farmers who meet higher conservation standards.143

• **Capitalize on new carbon trading and pollution mitigation markets.** Some greenhouse gas emitters and point-source water polluters can get mitigation credits by paying farmers to install offsetting conservation practices. This can be an important new source of funding for farm conservation. But these markets will not work if they require complex, case-by-case calculations and trades. There is also a danger in focusing on isolated practices to the exclusion of farm-wide performance. For example, a program might pay a farmer to plant a seasonal cover crop to sequester carbon in the soil; but if the farmer simultaneously plants more corn acres and applies more nitrogen fertilizer, the farm’s overall greenhouse gas footprint might actually increase. A proliferation of different trading standards and verification protocols may also lead to confusion, unfair competition and “green washing.”

• **Reduce food waste.** The U.S. should do its part to feed a hungry world, but not by destroying our nation’s land and water or accelerating global warming. We can reduce our environmental footprint and free up a lot of food for hungry people (including people right here in the U.S.), just by reducing food waste. The U.S. currently landfills over a third of its total food supply (household and retail waste). We should get serious, and achieve our stated national goal of reducing food waste by at least 50%.144

• **Help Midwest farmers reduce their reliance on corn ethanol fuel mandates.** In a hungry world, it makes little sense to deplete the world’s best farmland to feed U.S. cars. Corn ethanol has a big environmental footprint, and its bio-energy output scarcely exceeds the fossil fuel inputs needed to produce it. Ethanol mandates have also fueled a speculative surge in farmland prices, which can hurt conservation and working farmers.145 As the U.S. transitions to electric vehicles,146 corn ethanol does not offer a sustainable future for farmers or the nation. We should provide farmers with viable alternative income streams that reward long-term resource conservation.

• **Foster farm service professionalism.** We should expect a high level of professionalism from farm service providers like crop consultants, input suppliers and manure haulers, who provide key advice and services to farmers. These service providers affect farm conservation in a big way, but may have conflicts of interest.

• **Have a coordinated strategy.** Current U.S. policy often works at cross-purposes. We should coordinate farm policy with environmental policy. Farm conservation performance targets should be geared to meet ambitious but realistic environmental goals. Federal agencies should work with each other, and with state authorities and food producers, as a coordinated team. State personnel (including university extension agents and Wisconsin’s network of county conservation authorities) can work directly with farmers and a more positively engaged food industry.

• **Restrain concentrated market power.** In recent decades, there has been a breathtaking concentration of power in our food system. We should systematically monitor, document and publicize these developments. We should also strengthen current antitrust laws, as needed, and take real action to restrain oligopoly power.147

• **Think about our food choices.** Consumers can have a big impact on food system choices, by voting with their food dollars and supporting conservation efforts. Better consumer information can help.
Notes:

1 Based on U.S. Department of Agriculture (USDA) statistics related to average U.S. per capita food consumption. See USDA Agriculture Factbook (2001-02), Chapter 2, “Profiling Food Consumption in America.”


3 Compare U.S. Census Bureau estimates of Wisconsin, U.S. and world populations for 1915 and 2015.


5 Owen, “Farming Claims Almost Half Earth’s Land, New Maps Show,” National Geographic News (December 9, 2005), citing research by the University of Wisconsin-Madison, Center for Sustainability and the Global Environment.


7 Ibid.

8 Ibid.

9 Wisconsin Department of Agriculture, Trade and Consumer Protection, Annual Fertilizer Tonnage Reports.

10 According to one study, only about 37% of the fertilizer nitrogen applied to corn is taken up by crop roots. Cassman et al., “Agro-Systems, Nitrogen Use Efficiency, and Nitrogen Management” (2002), University of Nebraska–Lincoln, Department of Agronomy and Horticulture Faculty Publications 356, https://digitalcommons.unl.edu/agronomyfacpub/356. The fate of the “unused” nitrogen is complex, but much of it finds its way to air (partly as nitrous oxide) and water (as nitrate).


12 Wisconsin Groundwater Coordinating Council, Report to the Legislature (2020)


15 USDA-ERS, Fertilizer use and price data set (2013).

16 Wisconsin Department of Agriculture, Trade and Consumer Protection, Annual Fertilizer Tonnage Reports.

17 See, e.g., Southgate et al., supra at 33-34; Deepak K. Ray et al., Yield Trends Are Insufficient to Double Global Crop Production by 2050, PLoS ONE 8-6 (online journal, June 19, 2013). In a speech to The Atlantic’s Food Summit, on April 26, 2011, USDA Deputy Secretary Kathleen Merrigan spoke of the need to increase world food production by 70% by mid-century. By one U.N. estimate, the world may consume 73% more meat and eggs and 58% more dairy products by 2050. (United Nations (FAO) projection cited in National Academy of Sciences, “The Critical Role of Animal Science Research in Food Security and Sustainability” (2015)).

18 Per United Nations, Food and Agriculture Organization (FAO).


20 USDA-NASS statistics. In 1950, the U.S. produced about 2.8 billion bushels of corn on roughly 83 million harvested acres. In 2014, the U.S. produced about 14 billion bushels of corn on about 83 million harvested acres. For charts showing production and acreage trends, see National Corn Growers website at http://www.worldofcorn.com/##.
Wisconsin.

Wisconsin.

California produces about 40 billion lbs. of milk each year, compared to 30 billion lbs. for Wisconsin. Wisconsin milk production per cow continues to increase steadily (some top cows can now produce at nearly 3 times the current state average – or 9 times the 1950 state average).


USDA-NASS, Wisconsin Cattle and Milk Review (February 2013), graph showing “Number of Milk Cows vs. Milk Per Cow: Wisconsin 1950-2012.” See also USDA-NASS statistics (Feb. 3, 2015) at http://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Dairy/mkpercow.pdf. Today’s cows are bred for ever-higher milk production. They are bigger, consume more feed, and produce more manure per cow. Milk production per cow continues to increase steadily (some top cows can now produce at nearly 3 times the current state average – or 9 times the 1950 state average).

Wisconsin applications, soil phosphorus levels have apparently been rising for decades, due to excessive fertilizer and manure applications, so more phosphorus is poised to enter lakes and streams during runoff events. The University of Wisconsin-Madison Soil Testing Laboratories, Wisconsin’s Historical 5-Year Summary Database, documents this long-term trend.

Wisconsin Department of Agriculture, Trade and Consumer Protection, Annual Fertilizer Tonnage Reports. Nitrogen fertilizer, whose manufacture requires huge inputs of natural gas, is produced in various states and foreign countries (not in Wisconsin). Phosphorus fertilizer is mined in various locations, including Florida and Africa (not in Wisconsin).

Matson, “Food, Land and Water: Can Wisconsin Find Its Way?” (2016) at pp, 15, 22 and 25; available at Wisconsinlineandwater.org (Food, Land and Water Project). Manure output was calculated using a standard regression analysis (Weiss et al.) and a standard American Society of Agricultural and Biological Engineers (ASABE) formula, based on Wisconsin cow numbers and milk output. Nitrogen and phosphorus content of manure was calculated by multiplying manure output by average N and P content per lb. of manure (derived from ASABE). Thanks to Ed Odgers, retired chief conservation engineer, WI Dept. of Agriculture, Trade and Consumer Protection.

In one series of studies, UW researchers found that nearly 20% of the nitrogen applied to corn at University of Wisconsin recommended agronomic rates, on silt-loam soil, eventually leached to groundwater as nitrate pollution. See Masarik et al., “Long-Term Drainage and Nitrate Leaching below Well-Drained Continuous Corn Agroecosystems and a Prairie.” Journal of Environmental Protection (January, 2014). Losses can be much higher when farmers (or their fertilizer suppliers) apply at higher rates or under less favorable conditions (e.g., just before large rainfall events, on sandy soils, or over shallow karst bedrock).

"While dairy farms of all sizes have the potential for substantial excess nutrient production, the potential appears to increase noticeably among larger dairy operations, particularly for phosphorus and as herd sizes exceed 1,000 cattle of all types. As dairy farming continues to consolidate into larger operations, this problem will likely become more widespread." MacDonald et al., “Profits, Costs, and the Changing Structure of Dairy Farming.” USDA-ERS, ERR 47 (September 2007), at 25.


Big livestock facilities enjoy significant economies of scale, except when it comes to manure disposal. Manure disposal costs per unit of output tend to increase rapidly with herd size, as manure hauling distances increase. That is an important economic factor limiting the size of dairy farms and other livestock operations. But if operators are allowed to "cut corners" on manure disposal (e.g., by applying too much manure near production sites), that natural economic constraint on herd size is removed. Operators who "cut corners" get an unfair competitive advantage, at the expense of local communities and the environment. Public subsidies for manure treatment and disposal may encourage even more herd growth and manure output, and give subsidized operators a further competitive advantage.

See, e.g., Burch et al., “Quantitative Microbial Risk Assessment for Contaminated Private Wells in the Fractured Dolomite Aquifer of Kewaunee County, Wisconsin,” Environmental Health Perspectives (June, 2021).

UW-Madison Soil Testing Laboratories, Wisconsin’s Historical 5-Year Summary Database.

In Wisconsin, concentrated animal feeding operations (CAFOs) with more than 1,000 “animal units” (about 700 dairy cows) are regulated as pollution “point sources” under the federal Clean Water Act, and must hold a permit from the Wisconsin Department of Natural Resources. Permitted CAFOs must meet standards spelled out by DNR rules contained in Wis. Adm. Code ch. NR 243. Among other things, these CAFOs must have adequate manure storage facilities and an adequate land base for manure spreading, based on state nutrient management standards. Ongoing compliance monitoring is limited, however.

Only about a third of Wisconsin farms even claim to have a nutrient management plan that meets state standards. See Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) website (Nutrient Management), and "Wisconsin Making Inroads in Managing Manure," DATCP News Release (April 14, 2015).

President Franklin D. Roosevelt, Letter to All State Governors on a Uniform Soil Conservation Law, February 26, 1937.
81 Ibid.
82 Ibid.
86 National Geographic, “New Jersey-Size ‘Dead Zone’ is Largest Ever in Gulf of Mexico” (August 2, 2017), citing the National Oceanic and Atmospheric Administration NOAA.
87 National Resources Inventory (NRI), USDA-NRCS and Iowa State University.
88 National Resources Inventory (NRI), USDA-NRCS and Iowa State University.
90 Chart does not include exported corn, which accounts for up to 20% of the U.S. corn crop and goes mainly for livestock feed in other countries.
93 In less than 3 decades, from 1982 to 2010, more than 24 million acres of U.S. farmland were lost to development alone. That is equivalent to nearly 70% of the total land area of Wisconsin. “The 2010 NRI: Changes in Land Cover/Use,” American Farmland Trust (based on USDA National Resources Inventory).
95 USDA-ERS, 2020 (citing EPA).
96 Wisconsin Department of Natural Resources, Wisconsin Greenhouse Gas Emissions Inventory Report (August, 2020)
97 Johnson, “Iowa Agriculture, Climate Change and SWAPA,” published in Bleeding Heartland blog (September 3, 2020).
98 Ibid.
102 Johnson, “Iowa Agriculture, Climate Change and SWAPA,” published in Bleeding Heartland blog (September 3, 2020).
Surpass 1.5°C of Global Warming

Cheap Natural Gas” (April 25, 2013)

The study also found that, citing USDA data, intellectual property and 96% for non-GMO varieties and 49% for non-GMO varieties. The average rental rate is nearly $140 per acre per year (higher in some areas). See UW-Madison Extension Farm Management, “Wisconsin Agricultural Land Prices” (2021). Average land prices tend to be much higher in more highly productive corn-growing regions such as Iowa. 

See, for example, “Farmer Age Increases as Obstacles for Young Farmers Grow,” Agri-View (May 15, 2018), which reports on a farmer who grows corn and soybeans on 450 acres, and spends about $70,000 per year on fertilizer.

The average price of Wisconsin farmland is over $4,000 per acre (but prices may exceed $10,000 per acre in some areas). The average rental rate is nearly $140 per acre per year (higher in some areas). See UW-Madison Extension Farm Management, “Wisconsin Agricultural Land Prices” (2021). Average land prices tend to be much higher in more highly productive corn-growing regions such as Iowa. 

See, for example, “Farmer Age Increases as Obstacles for Young Farmers Grow,” Agri-View (May 15, 2018), which reports on a farmer who grows corn and soybeans on 450 acres, and spends about $60,000 per year on seed. From 1995 to 2008, nationwide average corn seed prices increased 139% for GMO varieties and 49% for non-GMO varieties, while soybean seed prices increased 19% for GMO varieties and 96% for non-GMO varieties. Moschini, “Competition Issues in the Seed Industry and the Role of Intellectual Property,” Agricultural and Applied Economics Association, Choices (online publication, 2010), citing USDA data.


Ibid.

Hillier et al., “The Carbon Footprint of Food Crop Production,” Int J Life Cycle Assess 7:107–118 (2009). The study also found that, “Once nitrogen is accounted for, there are no major differences between organic, integrated or conventional farming practices.”

Scientific American – Sustainability Newsletter, “Fertilizer Plants Spring Up to Take Advantage of U.S.’s Cheap Natural Gas” (April 25, 2013), citing studies by orange juice manufacturers in the southern U.S.


See, e.g., Southgate et al., The World Food Economy (2007), at 221.
110 Matson, Tang and Wynn, “Seeds, Patents and Power: The Shifting Foundation of Our Food System” (2014), citing other sources. This paper may be downloaded, free of charge, from the Social Science Research Network (SSRN.com). Since 2014, when the paper was written, industry concentration has continued: Dominant global seed companies (including Monsanto, DuPont and Syngenta) have merged with global chemical giants (Bayer, Dow and China Chemical, respectively) – further tightening oligopoly control over farm seed and chemical inputs. The merged DowDuPont Company subsequently consolidated its agricultural chemical and seed operations into a single spinoff company, Corteva. Bayer-Monsanto and Corteva are now the dominant powers in the U.S. corn and soybean seed industry. Most familiar corn and soybean seed brands, such as Pioneer and DeKalb, are actually owned or controlled by these global giants.

111 United Nations, Intergovernmental Panel for Biodiversity Ecosystem Services (IPBES) pollinator assessment (2016).


113 “Antibiotic Resistance Threats in the United States, 2013,” U.S. Department of Health and Human Services, Centers for Disease Control (2013). Some antibiotics are used to treat or prevent disease, but many are fed to promote animal growth. The CDC report says that the latter practice is unnecessary, and should be phased out. It also urges more limited use of livestock antibiotics for treatment purposes. In 2015, FDA moved to reduce agricultural use of antibiotics that are also used on humans, but not those used only on livestock. See “FDA Moves to Combat Superbugs,” *The Wall Street Journal* (June 3, 2015).

114 To cite just one of many examples: In 2015, a deadly avian influenza (bird flu) epidemic struck highly concentrated poultry facilities in the Midwest, killing nearly 50 million chickens and turkeys (including those euthanized to prevent further disease spread). Supply chains became a source of disease spread. Millions of birds were “composted in place” in the huge facilities where they died, because there were few other disposal options. The disease cost nearly $1 billion and 6,000 jobs in Iowa alone (farm operator losses were partly indemnified by U.S. taxpayers). Other states, including Minnesota and Wisconsin, were also hit hard. U.S. egg prices rose dramatically, and at least 75 nations restricted imports of U.S. poultry products. Some poultry operators lost up to 5 million birds each. The 2015 avian influenza was not readily transmissible to humans, but other deadly forms are. Avian influenza could be the source of the next world pandemic.

115 FeedStrategy.com (July 20, 2020).


118 *Successful Farming* (March 5, 2012), citing research by USDA-ARS.

119 Assumes average U.S. corn yield per acre, as reported by USDA.


122 Buzby et al., “The Estimated Amount, Value, and Calories of Post-Harvest Food Losses at the Retail and Consumer Levels in the United States,” USDA-Economic Research Service (USDA-ERS), Economic Information Bulletin No. EIB-121 (February, 2014). Estimating waste by weight has its shortcomings, because it may include things like cooking loss. Even so, the waste is considerable.


124 Wisconsin consumes roughly 5.5 million tons of food a year, based on current state population and USDA statistics related to average U.S. per capita food consumption. See USDA *Agriculture Factbook* (2001-02), Chapter 2, “Profiling Food Consumption in America.”

Instructing federal agencies to take more aggressive action to address anticompetitive market concentration in the U.S. economy.

On July 9, 2021, President Biden issued an executive order instructing federal agencies to take more aggressive action to address anticompetitive market concentration in the U.S. economy.

https://www.whitehouse.gov/cea/blog/2021/07/09/the-importance-of-competition-for-the-american-economy/. It remains to be seen how this will affect food industry consolidation.


135 Corn statistics refer to “field corn,” which represents the overwhelming majority of all corn grown in the U.S. “Sweet corn” is a much smaller specialty crop grown for direct human consumption in fresh, canned or frozen form. In 2014, according to USDA statistics, U.S. farmers planted 90.6 million acres of “field corn” and only 555 thousand acres of “sweet corn” (includes “sweet corn” for fresh market consumption as well as processing) – a ratio of over 163 acres of “field corn” to every acre of “sweet corn.” Wisconsin is a leading “sweet corn” state, and an important “field corn” state.


137 U.S. Energy Information Administration, “Corn Ethanol Yields Continue to Improve” (May, 2015).


140 Johnson, “Iowa Agriculture, Climate Change and SWAPA, published in Bleeding Heartland blog (September 3, 2020).

141 This is a very rough estimate assuming 1% of $1.3 trillion in annual U.S. retail food and beverage sales, divided among farmers per current USDA state cropland allocation formula. Incentive payment amounts and aggregate costs would depend, in part, on the number of farmers who qualify by meeting relevant conservation standards.

142 See notes 74 and 77, supra.

143 Other types of farm subsidies, including certain farm tax breaks, could also be tied to conservation compliance. Wisconsin’s farmland preservation program offers income tax credits to qualifying farmers who meet farmland protection and conservation standards (the credit is paid, regardless of income tax liability). The same principle could be extended to other farm tax relief programs. In Wisconsin, for example, “use value” property tax assessment and the manufacturers and agriculture income tax credit (MAC) could be made contingent on conservation compliance.


146 General Motors has announced that it plans to completely phase out vehicles using internal combustion engines by 2035. Statement issued by GM Chairman and Chief Executive Officer Mary Barra, January 28, 2021.

147 Part of the weakness of U.S. antitrust law, as recently interpreted by the courts and enforcement agencies, stems from its failure to address market concentration and monopsony (market power vis-à-vis sellers, not just buyers). See, e.g., Carstensen, “Emerging Issues in Buyer Power Analysis,” ABA Antitrust Section, Agriculture and Food Committee e-Bulletin (Winter 2012, vol 3, no. 1). The European Union has taken steps to address these issues, and some U.S. states are proposing similar measures. See, e.g., New York’s proposed “21st Century Antitrust Act,” NY Senate Bill 933 (2021-22).

https://legiscan.com/NY/text/S00933/2021. On July 9, 2021, President Biden issued an executive order instructing federal agencies to take more aggressive action to address anticompetitive market concentration in the U.S. economy: https://www.whitehouse.gov/cea/blog/2021/07/09/the-importance-of-competition-for-the-american-economy/. It remains to be seen how this will affect food industry consolidation.