Champions of Breakfast

How Cereal-Makers Can Help Save Our Soil, Support Farmers, and Take a Bite out of Climate Change

HIGHLIGHTS

Just four companies account for 86 percent of the $8.5 billion US breakfast cereal market, and these market leaders are well positioned to help grain farmers achieve environmental and economic sustainability. Big food companies, including cereal-makers, can channel their purchasing power and leverage their supply chains to support US farmers transitioning to grain production systems that better protect soil and water. We analyzed the potential benefits that could accrue if more farmers shifted their practices at scales relevant to companies that produce, and individuals who enjoy, breakfast cereals, and we found that these benefits could be substantial—for the nation's soil and water resources and for our climate. We propose that companies can support such transitions in ways that improve the productivity, profitability, and well-being of farmers over the long term.

Grains. Many of us start our day with a helping of them in the form of breakfast cereal—but we rarely think about what goes into the flakes, squares, puffs, or clusters in our bowl. For most cereal brands, the main ingredients are corn, wheat, rice, and oats, crops grown across tens of millions of acres in the United States and elsewhere. And although consumers do not often realize it, the way that most grains are grown today is undermining the health of our nation's soil and water and the long-term success of farmers. Grain farming is a major component of today's agricultural sector, which is a significant driver of water pollution, soil erosion, biodiversity loss, and heat-trapping emissions (Sánchez-Bayo and Wyckhuys 2019; USDA 2018a; USGCRP 2018; EPA 2016).

A number of big food companies—including some cereal-makers—have made public commitments to reduce the environmental impact of their products by purchasing grains and other ingredients produced in better ways. Such commitments should be expanded and converted to action quickly. Engaged consumers can play an important role in calling for follow-through and encouraging even more change, faster. For this report, we developed three scenarios to explore the potential benefits that would follow from big

JGI/Jamie Grill

In today's agricultural system, cereal grains such as corn, oats, wheat, and rice are often produced in ways that degrade soil, pollute water, and contribute to climate change. Big food companies can support the transition to farming practices that are more sustainable, and do so in ways that boost the profitability and well-being of farmers, especially those who are young, beginning, and socially disadvantaged.

Union of Concerned Scientists

cereal-makers—or others with a vast, grain-dominated supply chain—purchasing more grains grown more sustainably. We looked also at stronger public policies that would be needed, simultaneously, to help farmers make this shift to meeting our nation's demand for grains in better ways. This report describes a path to benefits we would all share: cleaner water, healthier ecosystems, and enhanced climate resilience.

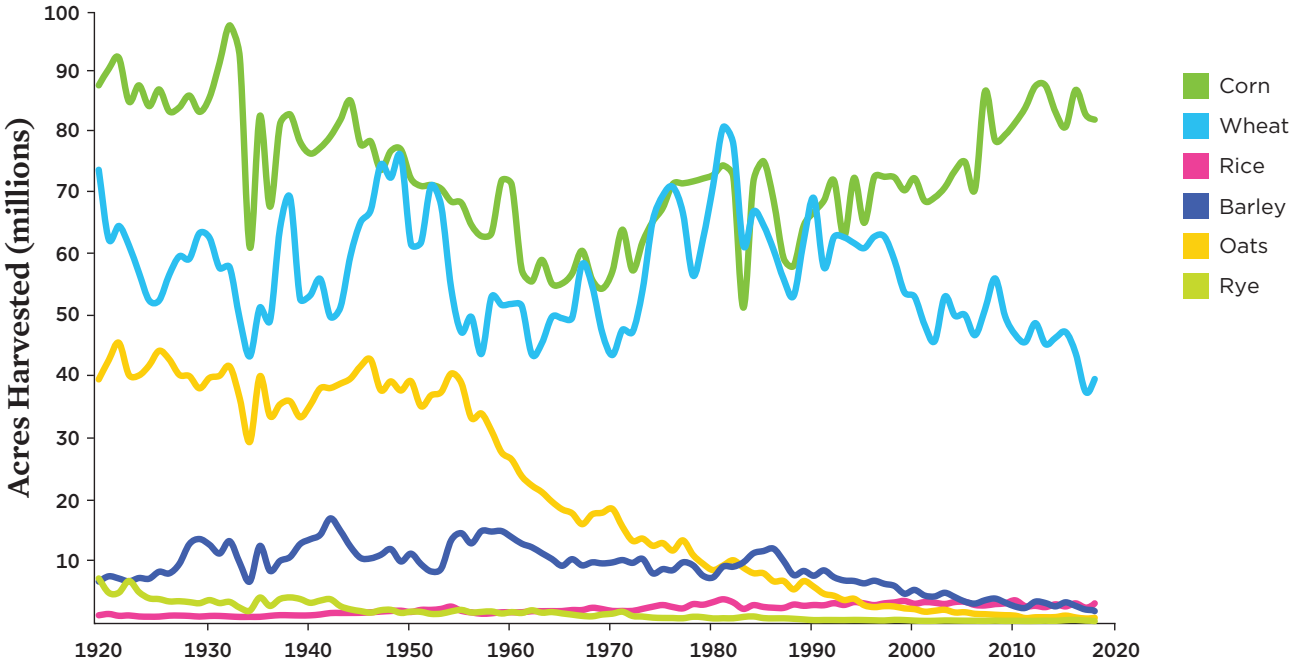
Unintended Consequences of US Grain Production

In recent decades, US agriculture as a whole, and grain production in particular, has become dominated by a few major crops. In 2017, corn covered more than 89 million acres (an area about the size of New Mexico), and wheat covered 46 million acres (an area about the size of Washington) (see figure; see also our technical appendix at *www.ucsusa.org/champions-of-breakfast*). By contrast, oats, which were once commonly grown by US farmers and helped to diversify production, have all but disappeared from the landscape.

USDA/Bob Nichols

When soils are degraded, they hold less water, exacerbating the impacts of both drought and flood events. Utilizing farming practices such as crop rotations and cover crops maintains the health of soil and can reduce flooding and increase resilience on farmlands.

US Grain Crops Lack Diversity



In the United States, corn has been the dominant grain in terms of acres harvested for most of the past century, with wheat covering more acres only during select years from the mid-1940s through 1980s, and other grains' shares remaining low or decreasing over time. This lack of crop diversity is mirrored in many of the nation's farming regions, and contributes to challenges such as soil degradation and increases in damaging pests.

SOURCE: NASS 2019A.

While they still find their way to our breakfast tables, they are often imported from elsewhere. Reduced diversity on US farms can also be seen in the dwindling, in recent decades, of other grains such as barley and rye. What we are left with is an overly simplistic agricultural system that covers tens of millions of acres—a system that is vulnerable to pests and weeds, requires large quantities of fertilizers and toxic pesticides, and severely damages the soil.

Soil erosion and degradation is a significant problem in the United States, and although erosion rates have decreased since the 1980s, many areas still face high rates of soil loss, and climate change is expected to intensify the problem (USDA 2018a; USGCRP 2018). Production of grains and a few other dominant crops contribute to the problem, as current farming practices often involve plowing fields and leaving them bare and susceptible to erosion between growing seasons (Claassen et al. 2018). Further, these crops are often cultivated continuously on the same fields, as monocultures, frequently in areas previously covered with diverse ecosystems such as grasslands and wetlands. Common practices also limit the soil's capacity to absorb and hold water, increasing the flow of water through and from farms (Wheater and Evans 2009; Raymond et al. 2008; O'Connell et al. 2007) and turning valuable soil nutrients, nitrogen fertilizers, and pesticides into pollutants. These pollutants contaminate drinking water sources, threaten public health in many communities, and damage fisheries and ecosystems, all at great cost to society (EPA 2016; Mulik 2016; Sobota et al. 2015). For example, high nitrate concentrations in drinking water have been associated with cancers and birth defects. Yet such pollution problems remain unresolved; moreover, the consequences of polluted water are not equally distributed, with some communities suffering more than others (Schaider et al. 2019; Pennino, Compton, and Leibowitz 2017).

Degraded soil, compared with healthy, "spongy" soil, leaves farms and downstream communities at greater risk from damaging and costly effects of both floods and droughts (Basche 2017). Finally, farming in these ways misses an opportunity to address climate change by moving more carbon out of the atmosphere and into soils (Harden et al. 2017; Paustian et al. 2016).

Opportunities for Agriculture to Better Protect Soil and Water

The agricultural system that produces most of today's limited assortment of major grain crops causes considerable environmental damage and puts at risk the health of the land on which farmers—and all of us—rely. Fortunately, there are science-based farming practices that can help solve many of these problems while ensuring that farming is viable for the long term (NRC 2010). For example, farmers can plant cover crops to protect their soils during times when their main crops are not growing. With this practice, living roots soak up nutrient-rich water before it escapes to surrounding waterways. Cover crops that are legumes have the further benefit of enriching soils with nitrogen from the atmosphere, which can lessen the need for added fertilizers for subsequent crops. Conservation tillage, which involves little or no plowing, is also beneficial. By leaving soil undisturbed and keeping organic matter in the ground, farmers can reduce or even reverse soil erosion and soil carbon losses.[1]

Another way for farmers to improve soil health is through crop rotations involving three or more crops, rather than just one or two. Such crop rotations break up pest cycles (thus reducing the need for pesticides) and can incorporate crops that have a variety of additional benefits. For example, there is growing interest from Midwestern farmers in incorporating small-grain crops such as oats, wheat, barley, rye, and triticale into corn-soybean systems (Greenaway 2017).[2] Rotated with summer corn and soybeans, these cool-season grain crops help keep soil protected and leave farmers time to grow cover crops. In another example, Montana farmers have found that crop rotations that include lentils—a legume requiring little moisture—have helped build soil health and increase farm resilience in an arid region (Carlisle 2015). Perennial plants provide still another way to protect soils and prevent water pollution. Farmers can grow perennial crops such as alfalfa as part of extended crop rotations, or plant small areas of perennial plants such as prairie grasses,

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Cover crops, such as red clover shown here, can be planted when main crops aren't growing. They prevent erosion, soak up nutrient-rich water before it escapes to surrounding waterways and help build soil health.

wildflower mixes, and even trees in and around crop fields (Liebman and Schulte 2015; Liebman et al. 2013).

Recent research has shown how these and other farming practices that protect soil and water—sometimes called regenerative or healthy-soil farming systems—can be combined and scaled up to deliver substantial benefits for combatting floods, drought, water pollution, and erosion. An analysis by the Union of Concerned Scientists (UCS) found found that scaling up soil-covering practices in Iowa could reduce runoff in flood years by nearly one-fifth and cut flood frequency by the same amount, while also making as much as 16 percent more water available for crop use during dry periods (Basche 2017). Similarly, research from Iowa State University showed that the practice of planting pollution-preventing prairie strips on just 10 percent of corn and soybean fields had outsized impacts—greatly increasing pollinator abundance and native bird species richness while decreasing the loss of soil and phosphorus from watersheds—and that farmers could scale up this practice to cover at least 9.6 million acres of cropland that are highly vulnerable to erosion within Iowa alone (Schulte et al. 2017).[3] Another long-term Iowa State University field experiment found that moving from standard corn-soybean rotations to improved crop rotations could reduce soil erosion by up to 60 percent and nitrogen runoff by up to 39 percent, while maintaining or increasing crop yields and farmers' profits (Hunt, Hill, and Liebman 2019). Building on these results, UCS analysis found that similar systems could be adopted gradually on 20 to 40 percent of Iowa's farmland in a way that is economically stable over time (Mulik 2017).

Despite growing evidence of the benefits of these healthy soil practices, relatively few farmers have adopted them. For example, only 12 percent of US crop farms were using cover crops as of 2017, and these crops covered just 5 percent of harvested cropland (NASS 2019b; see also the technical appendix). This practice is increasing, but there is still a long way to go. Conservation tillage and no-till are more common than cover crops and can also reduce soil erosion and improve soil health, but these have been associated with higher use of herbicides and mineral fertilizers (VandenBygaart 2016).

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Matt Liebman/Iowa State University

Our current agricultural system's emphasis on monoculture—a single crop grown across a large acreage, year after year—leaves farms vulnerable to pests and degrades soil. This long-term Iowa State University experiment that rotates corn and soybeans with oats, alfalfa, and cover crops shows how farmers can break up pest cycles, reduce fertilizer and pesticide use, and prevent erosion.

What is preventing wider adoption of beneficial healthy-soil practices? A major barrier is the lack of markets that value and compensate farmers for these practices, which protect soil and water but often come with up-front costs.

Breakfast Cereal as a Lever for Change

Our morning cereal bowl is where many of us encounter the grains grown on US farmland, such as corn, wheat, rice, and oats. A 2018 survey showed that nearly 9 out of 10 Americans eat cold breakfast cereals at least once in a while (Statista 2019). While the breakfast food industry is a relatively minor user of US grains, cereal is a beloved and highly visible lever for improving the sustainability of our farm and food system.[4] The leading cereal companies have significant power to catalyze larger change in the food industry through their purchasing decisions for wide-ranging product lines. (Though not the focus of this report, these same companies also have responsibility for the nutritional content of their products; see Box 1.)

With just four companies controlling 86 percent of the $8.5 billion cereal market, the industry leaders are highly recognizable (Burrows 2018). Many of their brands are household names, and the biggest companies have also acquired familiar smaller brands. Moreover, these large companies make more than just cereal. For example, General Mills produces more than 100 brands, including bakery and snack items (Pillsbury, LaraBar) and dairy products (Häagen-Dazs, Yoplait). PepsiCo boasts 22 brands that generated more than $1 billion each in retail sales in 2017, including Quaker Oats, Lay's, Doritos, Tostitos, and Fritos, in addition to

hundreds of smaller brands. Kellogg Company produces more than 1,600 foods, with popular brands such as Nutri-Grain, Eggo, and Pop-Tarts. By investing in supply chain improvements, defining sustainability standards, and raising consumer awareness, these companies have significant power to set the wheels in motion for larger-scale market adoption of more sustainable grain production.

Recently, leading cereal-makers and other major food companies have begun to step up. General Mills has pledged to shift 1 million farm acres to regenerative agriculture practices, including crop rotations, by 2030 (General Mills 2019). The company's Cascadian Farms subsidiary also recently introduced a new cereal featuring Kernza®, a perennial grain crop being bred from intermediate wheatgrass by scientists at The Land Institute (Charles 2019). Other major multi-stakeholder initiatives are also focused on more sustainable grains, including Field to Market and the Midwest Row Crop Collaborative.[5] PepsiCo, General Mills, and Kellogg Company are all engaged with these initiatives.

While these initial commitments are promising, they must be implemented and expanded rapidly to drive real changes at the needed scales. Consumers can play an important role by holding companies accountable for follow-through and rewarding them for even greater and faster change. For this report, we analyzed the impact of big cereal-makers' buying more grains grown in more sustainable, soil-building ways and offer recommendations for how food companies, government policymakers, and customers can help accelerate such changes.

The Farm Footprint of Top Cereal Companies

The goal of this analysis was to gain a better understanding of how familiar foods and food companies, particularly those linked to many people's daily breakfasts, could do more to help solve some of US agriculture's climate and environmental challenges.

To assess the potential environmental impacts of the top cereal companies, we began by estimating the number of boxes of the most popular cereal brands sold annually. For these estimates, we identified the most popular corn- and oat-based breakfast cereals in the United States and divided total sales values (Statista 2019) by retail prices per box in Des Moines, Iowa.[6] We assumed that grain accounted for the weight of all non-sugar ingredients[7] and determined the number of acres needed to produce this quantity of corn and oats (see our online technical appendix for more details).[8]

Of the top 10 cereals in 2017, four had oats as the primary ingredient: Honey Nut Cheerios, Cheerios, Lucky Charms, and Honey Bunches of Oats. Two of the top cereals had corn

BOX 1.

Can Processed Cereal Be Part of a Healthy Food System?

While this report focuses on the sustainability of breakfast cereals for the environment and for farmers, it is important to recognize that the industry has also been criticized for the low nutritional content of much of its product line. While cereal is generally an affordable and readily available source of calories, vitamins, and minerals that does not require cooking or other preparation (Fulgoni and Buckley 2015), many leading cereal brands are high in added sugars, and cereals geared toward children remain the least healthy products in company portfolios (Harris et al. 2012). Research also shows that children of color have disproportionately high exposure to advertisements for sugary cereals (Harris et al. 2019; Harris et al. 2012).

One alternative breakfast food that is generally more nutritious and could help trigger similar or larger societal benefits is oatmeal. However, even focusing on oatmeal could have unintended consequences. For example, if customers switched from unsustainably produced fortified cold cereals to more sustainably produced unfortified oatmeal, environmental benefits could come at the cost of reduced intake of some vitamins and minerals in the poorest households. Other potential unintended consequences of new sourcing or purchasing patterns should also be considered. For example, if breakfast product prices were to increase due to sustainability efforts, it would negatively affect low-income communities, including some communities of color.

Therefore, although the focus of this report is on the potential positive environmental impacts of corporate sourcing choices, it is important to consider how those could affect communities' access to healthy food choices, particularly in ways that may be difficult to predict. These tradeoffs highlight the need for companies to carefully consider the consequences of their actions across both environmental and social outcomes, as well as the need for societal action to reduce income disparity and improve access to healthier food choices for all.

USDA/Lance Cheung

By incentivizing farms focusing on corn and soybean production to adopt rotations including oats (shown here) and cover crops, big food companies can help improve soil quality, reduce heat-trapping emissions, and improve farmer livelihoods.

as the primary ingredient: Frosted Flakes and Froot Loops. Combined, these products represented $2.1 billion in cereal sales, about 25 percent of the total ready-to-eat cereal market (Statista 2019). We estimated that these six breakfast cereals accounted for approximately 7 billion servings, enough for 22 servings per person in the United States, and 219,558 acres of grains harvested each year.

The amount of grain (and acres) needed to produce just the most popular corn- and oat-based cereals, Kellogg's Frosted Flakes and General Mills' Honey Nut Cheerios, is noteworthy. Producing the estimated 1.7 billion servings of Frosted Flakes sold in 2017 likely required around 13,000 acres of land. For Honey Nut Cheerios, the estimated 1.8 billion servings sold in 2017 likely required grain grown on 61,000 acres. For perspective, 1.8 billion servings are enough for one serving per day for 4.9 million people—or nearly everyone in Chicago, Illinois; Columbus, Ohio; Indianapolis, Indiana; and Minneapolis-St. Paul, Minnesota, combined.

Estimating the Benefits of Better Grain Sourcing: A Case Study in the Corn Belt

Given the magnitude of cereal consumption and its grain usage, we developed three scenarios to explore how big cereal companies—or others with a vast, grain-dominated supply chain—could foster better soil health and water quality by sourcing more grains from farmers using healthy-soil practices. It is worth noting that cereal's frequent companion—milk—could be a lever for further improvements, although it is not the focus of this study (Box 2).

We based the acreage for these scenarios on estimates of grains used annually for top corn- and oat-based cereals, as described above. We then evaluated the potential benefits of soil-health practices based on research from the heart of the US Corn Belt. Our estimates were informed by long-term research at Iowa State University that identified a number of benefits for farmers and the environment from transitioning corn-soybean production to more sustainable three- or four-crop rotations (incorporating corn, soybean, oats, and alfalfa) (Hunt, Hill, and Liebman 2019) as well as a modeling study that simulated the benefits of scaling up similar cropping systems across Iowa (Mulik 2017) (Table 1). Finally, we used published estimates to quantify potential societal benefits such as cost savings for water cleanup

BOX 2.

What about Milk?

Cereal's frequent companion, milk, is also closely linked to grain production systems. To feed their cows, US dairy farmers rely on many of the same grains that cereal companies do, including corn, oats, and wheat (Adom et al. 2012). Dairy farmers also rely on alfalfa, which can be added to crop rotations to build soil health, as both a feed for cows and as a source for hay. This means that companies selling dairy products also have the opportunity to source crops from farmers using the most sustainable farming systems.

While not the central focus of this study, there are also several other ways for dairy farmers to improve the sustainability of their products. For example, dairy manure and digestive methane emissions are sources of heat-trapping emissions that can be reduced, such as by improving manure management and optimizing cattle diets.

Another thing to keep in mind is that not all "milk" comes from cows or other animals. But regardless of the product we pour over our cereal, whether organic dairy, pasture-raised dairy, or plant-based "milks" (such as soy, oat, or almond), each cup comes with more opportunities to support farmers and companies working to build soil health and a more resilient food and farm system.

TABLE 1. Potential Improvements from Healthy-Soil Practices in Corn-Soybean Systems in Iowa

	Cropping System with Corn, Soybeans, Oats, and Cover Crops	Cropping System with Corn, Soybeans, Oats, and Alfalfa
Reduced Erosion	410 kg soil/acre	650 kg soil/acre
Reduced Heat-Trapping Emissions from Nitrogen Fertilizers*	130 kg CO_2e/acre	190 kg CO_2e/acre
Reduced Nitrogen Runoff	1.46 kg N/acre	1.58 kg N/acre
Reduced Phosphorus Runoff	0.32 kg P/acre	0.28 kg P/acre

Research from Iowa State University has shown that changes in farming practices, such as increasing crop diversity and including cover crops, can reduce soil erosion, heat-trapping emissions, and water pollution.

Notes: In the Iowa State University study, the original corn-soybean system had soil sediment yields of 1,050 kg soil/acre, N_2O from fertilizer of about 590 kg CO_2e/acre, nitrogen runoff of 4.05 kg N/acre, and phosphorus runoff of 0.38 kg P/acre. Outcomes of shifting from corn-soybeans to one of these more diverse rotations will depend significantly on a number of variables including soil type, topography, weather and climate, and specific management practices.

* This calculation was based on a reduced nitrogen fertilizer rate (manure plus synthetic), and was made using a non-linear emissions factor (Millar et al. 2010). Heat-trapping emissions are expressed in terms of carbon dioxide equivalent (CO_2e); we assume that one unit of N_2O is equivalent to 298 units of CO_2 in terms of heat-trapping ability over a 100-year time horizon (IPCC 2014).

SOURCE: HUNT, HILL, AND LIEBMAN 2019.

(NRCS 2009), reduced nitrogen pollution in surface water (Sobota et al. 2015), and reduced emissions of heat-trapping gases (EPA 2018).

It is important to note that in our analysis we considered only one possible set of changes—the transition of corn and soybean acreage to a more sustainable rotation of corn, soybeans, oats, and a cover crop—and that outcomes will necessarily vary. Even within this system the economic and environmental outcomes would fluctuate from year to year, across different landscapes and soil types and in response to different farming practices (Al-Kaisi et al. 2015). However, given that a growing body of research on the impacts of farming practices on soil and water resources shows the potential for similar outcomes in other systems and circumstances, we considered this analysis a firm basis from which to explore the broader benefits of scaling up healthy-soil management.

We evaluated the potential benefits of the following company actions:[9]

- Committing to purchase 10,000 acres worth of corn—about the amount of corn used to produce all the Frosted Flakes sold in 2017—from farms that transitioned from corn and soybean production to corn grown in more sustainable cropping systems with oats and cover crops (Scenario 1).
- Committing to purchase 60,000 acres worth of oats—about the amount used to produce all the Honey Nut Cheerios sold in 2017—from farms transitioning from corn and soybean production to more sustainable cropping systems with oats and cover crops (Scenario 2).
- Committing to purchase 140,000 acres of oats from farms transitioning from corn and soybean production to more sustainable cropping systems with oats and cover crops (Scenario 3).[10] This represents the amount of oats that would be needed to produce an equivalent number of servings (1,800) of whole grain oatmeal—such as Quaker Oats—as compared with the grains required to produce a top-selling ready-to-eat cereal brand.

Our analysis of these three scenarios (summarized in Table 2) showed that even relatively small commitments in food company purchasing could generate substantial benefits for both farmers and the environment.

Scenario 1. We estimated that if a company purchased the amount of corn used annually in the top-selling corn-based cereal—Kellogg's Frosted Flakes—using more sustainable sourcing standards, it could prompt the transition of 10,000 acres of cropland to a more environmentally sustainable system, or up to 30,000 acres if the transition was to a three-crop rotation. Based on our calculations using assumptions from long-term research from Iowa State University (as described above and in Table 1), this relatively small commitment could prevent the loss of up to 12,150 metric tons of soil per year from farm fields and save up to $69,134 annually in costs associated with unclogging waterways full of eroded soils. It could reduce emissions of nitrous oxide, a potent heat-trapping gas stemming from fertilizer use, by up to 3,939 metric tons of carbon dioxide equivalent (CO_2e),[11] a climate benefit similar to taking 840 cars off the road. Furthermore, nitrogen and phosphorus runoff could be reduced by 44 metric tons and 10 metric tons, respectively, resulting in additional benefits. The avoided costs of surface freshwater pollution from nitrogen could reach around $827,000.

Scenario 2. In our second scenario, we found that if a company purchased the amount of oats used annually in the top-selling oat-based cereal—General Mills' Honey Nut Cheerios—using more sustainable sourcing standards, it could prompt the transition of 60,000 acres of cropland to a more

TABLE 2. Potential Improvement from Sourcing More Sustainable Grains in Breakfast Cereal

Grain Crop Needed	Scenario 1 (10,000 Acres)	Scenario 2 (60,000 Acres)	Scenario 3 (140,000 Acres)
Potential Land Transitioned	10,000–30,000 acres	60,000–180,000 acres	140,000–420,000 acres
Reduced Erosion	4,050–12,150 MT soil	24,300–72,900 MT soil	56,700–170,100 MT soil
Reduced Heat-Trapping Emissions from Nitrogen Fertilizers	1,313–3,939 MT CO_2e	7,879–23,637 MT CO_2e	18,384–55,125 MT CO_2e
Reduced Nitrogen Runoff	15–44 MT N	88–262 MT N	204–612 MT N
Reduced Phosphorus Runoff	3–10 MT P	19–58 MT P	45–140 MT P

Notes: One metric ton (MT) is equal to one megagram, or 1,000 kilograms. Expected improvements are based on a transition from corn-soybean farming to a more sustainable crop rotation with corn, soybeans, oats, and cover crops. To illustrate the potential to trigger larger landscape changes through implementing crop rotations, we estimated the benefits that would accrue if each acre purchased for the needed breakfast cereal grain represented just one crop in a sustainable three-crop rotation. For example, committing to purchase just one acre of oats from a three-crop rotation could help to ensure more sustainable practices across three acres (one acre of corn, one acre of soybeans, and one acre of oats). Note that these scenarios represent a relatively small shift in acres relative to total cropland and acres currently planted in corn and soybeans. For comparison, in 2017 in Iowa there were about 24 million acres of cropland, 13 million acres of corn grain harvested, and 37,000 acres of oats harvested. Thus, transitioning 420,000 acres in Iowa would represent just 1.75% of Iowa's croplands, suggesting that this represents a relatively modest goal and points to substantial additional opportunity.

SOURCE: CALCULATIONS ARE BASED ON DATA DESCRIBED IN TABLE 1 AND IN HUNT, HILL, AND LIEBMAN 2019.

sustainable cropping system, or up to 180,000 acres if the transition was to a three-crop rotation. This change could prevent up to 72,900 metric tons of lost soil from erosion and save up to $414,801 in yearly water cleanup costs. Additionally, nitrous oxide emissions could be cut by up to 23,637 metric tons of CO_2e, a climate benefit about equal to taking 5,040 cars off the road. In this case, nitrogen and phosphorus runoff could be reduced by 262 metric tons and 58 metric tons, respectively. Here, the avoided costs of surface freshwater pollution from nitrogen could reach $5 million.

Scenario 3. Finally, we determined that if a company purchased 140,000 acres worth of oats each year using more sustainable sourcing standards, it could prompt the transition of up to 420,000 acres of cropland to more sustainable cropping systems. This change could reduce soil erosion by up to 170,100 metric tons, nitrous oxide emissions by up to 55,142 metric tons of CO_2e, nitrogen runoff by 612 metric tons, and phosphorus runoff by 136 metric tons. The benefits could include reducing water cleanup costs by nearly $1 million, reducing damage from surface water nitrogen pollution by nearly $12 million, and attaining climate benefits (from avoided nitrous oxide emissions) equivalent to taking 11,760 cars off the road.

Corporate Actions and Public Policies Needed to Support Farmers and Protect Natural Resources

The scenarios in this analysis are relatively modest, at the scale of a few individual cereal brands. But the environmental, economic, and climate benefits of shifting the practices farmers use to grow grains on a larger scale would be enormous. Yet, change for farmers often involves up-front costs and learning curves that prevent these practices from being scaled up without support. Such support can take the shape of corporate commitments from cereal-makers and others to buy crops produced more sustainably, along with state and federal policies to ease farmers' transition and ensure that changes benefiting the environment also benefit farmers and benefit consumers, avoiding adverse impacts on families and public health. UCS recommends both approaches. In particular:

- **Cereal-makers and other major grain purchasers should establish strong commitments to advance healthy-soil farming practices (or expand existing commitments) and implement such commitments swiftly.** Through their buying decisions, companies can give farmers more certainty that adopting healthy-soil practices such as extended crop rotations, cover cropping, reduced tilling, and planting perennials will pay off. Companies can expand their sourcing of sustainably grown grains, commit to purchasing all crops harvested in a healthy-soil rotation, or otherwise ensure that farmers will be compensated fairly for all rotation stages. To help build a strong agricultural system for the long term, companies should also track and strengthen their supports for young, beginning, and socially disadvantaged farmers.
- **Food companies should advocate for state and federal healthy-soil policies that accelerate or incentivize the production of sustainably grown grains as a complement to their own purchasing commitments.** State and federal policies have a strong influence on

agricultural practices and affect the amount and availability of US crops grown with healthy-soil practices. Food companies making commitments to source sustainably grown grains and to support the farmers producing these crops could accelerate their progress by supporting aligned policies. The Sustainable Food Policy Alliance is an example of one recent effort by food companies to advocate for policies that improve food system sustainability; however, for adoption rates of regenerative farming practices to increase to the levels required, additional advocacy—by many more companies—is needed.[12]

- **Policymakers in every state should introduce and implement policies that support farmers in adopting healthy-soil practices.** To date, several states have passed healthy-soil legislation and several additional states have introduced related bills. For example, in April 2019 the Nebraska state legislature approved a Healthy Soils Task Force, recognizing that healthy soils are a valuable but limited resource and are fundamental for food production. The task force will develop a comprehensive action plan to carry out a healthy-soil initiative "using standards for organic matter, biological activity, biological diversity, and soil structure as measures to assess soil health." Similar actions in every state are needed to improve soil health nationwide.
- **Congress and the US Department of Agriculture (USDA) should do more to drive farmers' transition to healthy-soil practices.** This includes:
    - ***Strengthening, expanding, and honing existing programs that provide up-front financial and technical support.*** Programs such as the USDA's Conservation Stewardship Program and Environmental Quality Incentives Program provide financial incentives that help farmers with the costs of transitioning their practices. Although funding for the Conservation Stewardship Program was reduced in the 2018 farm bill, some improvements were made to the program, including extra incentives for beneficial rotations such as the ones analyzed in this study. But the payment rates are low, and there is not enough support for all farmers who wish to participate. Expanding these programs, increasing payment rates, and more effectively targeting program resources toward practices that deliver soil-health outcomes will accelerate adoption of more sustainable practices.
    - ***Increasing the availability of technical assistance, through university-based cooperative extension services, to help farmers implement new practices and share knowledge.*** Resources should be targeted, wherever possible, to young, beginning, and socially disadvantaged farmers. Furthermore, new resources should be invested in technical assistance in order to ensure the USDA is actively providing growers with all relevant information on federal farm programs that support adoption of healthy-soil practices.
    - ***Creating new policy mechanisms to scale up the adoption of agricultural practices that generate benefits for farmers and the environment.*** Such mechanisms should rely in part on helping farmers capture the increased market value of sustainably grown products being driven by consumer and food industry interest.
    - ***Increasing funding of public-private partnerships.*** The USDA's Regional Conservation Partnership Program, for example, needs to be improved in order to enable greater numbers of stakeholders, including those from producer associations, nongovernmental organizations, and state or local governments, to support farmers in adopting conservation practices. Such partnerships should ensure that investments clearly benefit farmers and taxpayers.
    - ***Investing more in public research programs to enhance the environmental and social benefits of improved agriculture practices and to support new markets for crops used in diversified grain rotations.*** Public research programs including the USDA's Agriculture

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Cereal-makers and other big food companies can help farmers improve soil quality and reduce water pollution and climate emissions through purchasing decisions that expand markets for sustainable, multi-crop systems.

and Food Research Initiative, Sustainable Agriculture Research and Education Program, and Organic Agriculture Research and Extension Initiative need to be continually improved and expanded to address evolving challenges. For example, more research is needed to develop crop varieties and practices that help farmers adapt to changing climate conditions and to changing weeds and pests. Research can also help identify innovative uses for more sustainable grains and cropping systems, including for feeding livestock more sustainably.

- ***Advancing infrastructure for new crop rotations and profitable markets for added crops, such as small grains.*** Although investments for infrastructure should not be limited to federal policy, the Local Agriculture Market Program—which was reauthorized and received increased funding in the 2018 farm bill—is one example of a federal program critical to supporting supply chain infrastructure development. The USDA should implement the program fully and work closely with the stakeholder community. Among the top priorities for this program's implementation is the new regional partnership program, which allows the USDA to enter into partnership agreements in order to plan and develop regional food systems.

Finally, everyone who eats can play a role in creating a more sustainable food system with healthier soils. As eaters, we can engage with cereal-makers and other food companies to let them know our preferences and encourage them to take action. As taxpayers, constituents, and voters, we can urge policy-makers to do more as well.

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ENDNOTES

1 Sanderman, Hengl, and Fiske (2017) estimated that 133 petagrams of carbon have been lost due to agriculture, including on croplands and grazing lands, over the past 12,000 years. While it is estimated that only 10 to 30 percent of this carbon can be restored, this represents a substantial opportunity to shift carbon from the atmosphere to the soil.

2 The US Department of Agriculture's (USDA) National Small Grains Collection includes wheat, barley, oat, rice, rye, triticale, and their wild relatives (*www.ars.usda.gov/pacific-west-area/aberdeen-id/small-grains-and-potato-germplasm-research/docs/national-small-grains-collection*). The USDA also produces the Small Grains Annual Summary, which reports on the most common small-grain crops planted in the United States, including wheat, oats, barley, and rye (USDA 2018b).

3 Prairie strips are areas of corn and soybean fields planted with diverse native plant species with deep root systems (see *www.nrem.iastate.edu/research/STRIPS/content/what-are-prairie-strips*).

4 Current domestic grain production is dominated by corn, less than 2 percent of which goes to cereal and other food products, while most is used as livestock feed or for the ethanol industry (ERS 2019). Other commonly grown grains, such as rice and wheat, differ from corn in that they are used mostly for food products (including but not limited to cereal).

5 For more information, see *https://fieldtomarket.org and https://midwestrowcrop.org.*

6 We used prices for standard-sized (10- to 18- ounce) cereal boxes at a Walmart in Des Moines, Iowa. Prices were $2.98 per box for all cereals except Honey Bunches of Oats, which was $3.28 per box.

7 Grain products and sugar were the top two ingredients for the cereals used in this analysis, with salt, vitamins, minerals, and preservatives making up the remaining ingredients.

8 We assumed that one bushel of oats was equivalent to 32 pounds of unprocessed oats, 20.3 pounds of oat flour, or 18.5 pounds of oatmeal, and that one bushel of corn was equivalent to 56 pounds of shelled corn or 32.3 pounds of milled corn (ERS 1992).

9 These scenarios are specific to Iowa and are based on research from Iowa State University (Hunt, Hill, and Liebman 2019) that we used to provide rough estimates for the potential benefits of better crop sourcing.

10 We estimated that both Scenario 1 and Scenario 2 represented approximately 1,800 servings (of Frosted Flakes and Honey Nut Cheerios, respectively). More grains would be required for a serving of whole-grain oatmeal since the only ingredient in those servings is the grain (whereas the other breakfast cereals considered contain additional ingredients).

11 CO_2e is the unit used to describe global warming potential (GWP). GWP quantifies a gas's ability to trap heat in the atmosphere relative to an equal amount of carbon dioxide, over a specific timespan. The GWP of nitrous oxide over a 100-year timespan is 298 (IPCC 2014).

12 The Sustainable Food Policy Alliance includes founding members Danone North America, Mars, Nestle USA, and Unilever United States. For more information see *https://foodpolicyalliance.org.*

REFERENCES

All references accessed May 30, 2019.

Adom, F., A. Maes, C. Workman, Z. Clayton-Nierderman, G. Thoma, and D. Shonnard. 2012. Regional carbon footprint analysis of dairy feeds for milk production in the USA. *International Journal of Life Cycle Assessment* 17:520. Online at *https://doi.org/10.1007/s11367-012-0386-y*.

Al-Kaisi, M.M., S.V. Archontoulis, D. Kwaw-Mensah, and F. Miguez. 2015. Tillage and crop rotation effects on corn agronomic response and economic return at seven Iowa locations. *Agronomy Journal* 107(4):1411. Online at *https://doi.org/10.2134/agronj14.0470*.

Basche, A. 2017. *Turning soils into sponges: How farmers can fight floods and droughts.* Cambridge, MA: Union of Concerned Scientists. Online at *www.ucsusa.org/food-agriculture/advance-sustainable-agriculture/turning-soils-sponges*.

Burrows, D. 2018. America's most popular breakfast cereals (and the stocks behind them). Slide show. Washington, DC: Kiplinger. Online at *www.kiplinger.com/slideshow/investing/T052-S001-america-s-most-popular-breakfast-cereals-stocks/index.html*. Note: data credited to the market research firm IRI (*www.iriworldwide.com*).

Carlisle, L. 2015. *Lentil underground: Renegade farmers and the future of food in America*. New York: Penguin Random House.

Charles, D. 2019. Can this breakfast cereal help save the planet? National Public Radio, April 13. Online at *www.npr.org/sections/thesalt/2019/04/13/711144729/can-this-breakfast-cereal-help-save-the-planet*.

Claassen, R., M. Bowman, J. McFadden, D. Smith, and S. Wallander. 2018. Tillage intensity and conservation cropping in the United States. Washington, DC: US Department of Agriculture. Online at *www.ers.usda.gov/publications/pub-details/?pubid=90200*.

Economic Research Service (ERS). 2019. Feed grains database. Washington, DC: US Department of Agriculture. Online at *www.ers.usda.gov/data-products/feed-grains-database*.

Economic Research Service (ERS). 1992. Weights, measures, and conversion factors for agricultural commodities and their products. Agricultural handbook number 697. Washington, DC: US Department of Agriculture. Online at *www.ers.usda.gov/publications/pub-details/?pubid=41881*.

Environmental Protection Agency (EPA). 2018. Greenhouse gas equivalencies calculator. Online at *www.epa.gov/energy/greenhouse-gas-equivalencies-calculator*.

Environmental Protection Agency (EPA). 2016. National nonpoint source program: A catalyst for water quality improvements. EPA 841-R-16-009. Online at *www.epa.gov/sites/production/files/2016-10/documents/nps_program_highlights_report-508.pdf*.

Fulgoni, V., and R. Buckley. 2015. The contribution of fortified ready-to-eat cereal to vitamin and mineral intake in the US population, NHANES 2007–2010. *Nutrients* 7(6):3949–3958. Online at *https://doi.org/10.3390/nu7063949*.

General Mills. 2019. *Global Responsibility 2019*. Online at *https://globalresponsibility.generalmills.com/images/General_Mills-Global_Responsibility_2019.pdf*.

Greenaway, T. 2017. Where corn is king: The stirrings of a renaissance in small grains. New Haven, CT: Yale University. Online at *https://e360.yale.edu/features/where-corn-is-king-the-stirrings-of-a-small-grain-renaissance*.

Harden, J.W., G. Hugelius, A. Ahlström, J.C. Blankinship, B. Bond-Lamberty, C.R. Lawrence, J. Loisel, A. Malhotra, R.B. Jackson, S. Ogle, C. Phillips, R. Ryals, K. Todd-Brown, R. Vargas, S.E. Vergara, M.F. Cotrufo, M. Keiluweit, K.A. Heckman, S.E. Crow, W.L. Silver, M. DeLonge, and L.E. Nave. 2017. Networking our science to characterize the state, vulnerabilities, and management opportunities of soil organic matter. *Global Change Biology* 24(2):e705–e718. Online at *https://doi.org/10.1111/gcb.13896*.

Harris, J.L., W. Frazier, III, S. Kumanyika, and A.G. Ramirez. 2019. Increasing disparities in unhealthy food advertising targeted to Hispanic and black youth. Storrs, CT: University of Connecticut Rudd Center for Food Policy and Obesity. Online at *http://uconnruddcenter.org/files/Pdfs/TargetedMarketingReport2019.pdf*.

Harris, J.L., M.B. Schwartz, K.D. Brownell, V. Sarda, C. Dembek, C. Munsell, C. Shin, A. Ustjanauskas, and M. Weinberg. 2012. Cereal FACTS 2012: Limited progress in the nutrition quality and marketing of children's cereals. Storrs, CT: University of Connecticut Rudd Center for Food Policy and Obesity. Online at *www.cerealfacts.org/media/Cereal_FACTS_Report_2012_7.12.pdf*.

Hunt, N.D., J.D. Hill, and M. Liebman. 2019. Cropping system diversity effects on nutrient discharge, soil erosion, and agronomic performance. *Environmental Science and Technology* 53(3):1344–1352. Online at *https://doi.org/10.1021/acs.est.8b02193*.

Intergovernmental Panel on Climate Change (IPCC). 2014. *Climate change 2014: Mitigation of climate change: Working group III contribution to the fifth assessment report of the Intergovernmental Panel on Climate Change*, edited by O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel, and J.C. Minx. New York: Cambridge University Press. Online at *www.ipcc.ch/report/ar5/wg3*.

Liebman, M., M.J. Helmers, L.A. Schulte, and C.A. Chase. 2013. Using biodiversity to link agricultural productivity with environmental quality: Results from three field experiments in Iowa. *Renewable Agriculture and Food Systems* 28(2):115–128. Online at *https://doi.org/10.1017/S1742170512000300*.

Liebman, M., and L.A. Schulte. 2015. Enhancing agroecosystem performance and resilience through increased diversification of landscapes and cropping systems. *Elementa: Science of the Anthropocene* 3:000041. Online at *https://doi.org/10.12952/journal.elementa.000041*.

Millar, N., G. Robertson, P.R. Grace, R.J. Gehl, and J.P. Hoben. 2010. Nitrogen fertilizer management for nitrous oxide (N_2O) mitigation in intensive corn (maize) production: An emissions reduction protocol for US Midwest agriculture. *Mitigation Adaption Strategy and Global Change* 15(2):185–204. Online at *https://link.springer.com/article/10.1007/s11027-010-9212-7*.

Mulik, K. 2017. *Rotating crops, turning profits: How diversified farming systems can help farmers while protecting soil and preventing pollution*. Cambridge, MA: Union of Concerned Scientists. Online at *www.ucsusa.org/food-agriculture/advance-sustainable-agriculture/rotating-crops-turning-profits*.

Mulik, K. 2016. *Subsidizing waste: How inefficient US farm policy costs taxpayers, businesses, and farmers billions*. Cambridge, MA: Union of Concerned Scientists. Online at *www.ucsusa.org/our-work/food-agriculture/advance-sustainable-agriculture/subsidizing-waste*.

National Agricultural Statistics Service (NASS). 2019a. Quick stats. Washington, DC: US Department of Agriculture. Online at *https://quickstats.nass.usda.gov*.

National Agricultural Statistics Service (NASS). 2019b. 2017 census of agriculture. Washington, DC: US Department of Agriculture. Online at *www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usv1.pdf*.

National Research Council (NRC). 2010. Toward sustainable agricultural systems in the 21st century. Washington, DC: National Academies Press. Online at *https://doi.org/10.17226/12832*.

Natural Resources Conservation Service (NRCS). 2009. Interim final benefit-cost analysis for the Environmental Quality Incentives Program (EQIP). Washington, DC: US Department of Agriculture. Online at *www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_007977.pdf*.

O'Connell, E., J. Ewen, G. O'Donnell, and P. Quinn. 2007. Is there a link between agricultural land-use management and flooding? *Journal of Hydrology and Earth System Sciences* 11(1):96–107. Online at *www.sciencedirect.com/science/article/pii/S0264837709001082*.

Paustian, K., J. Lehmann, S. Ogle, D. Reay, G.P. Robertson, and P. Smith. 2016. Climate-smart soils. *Nature* 532(7597):49–57. Online at *https://doi.org/10.1038/nature17174*.

Pennino, M.J., J.E. Compton, and S.G. Leibowitz. 2017. Trends in drinking water nitrate violations across the United States. *Environmental Science and Technology* 51(22):13450–13460. doi: 10.1021/acs.est.7b04269.

Raymond, P.A., N. Oh, R.E. Turner, and W. Broussard. 2008. Anthropogenically enhanced fluxes of water and carbon from the Mississippi River. *Nature* 451:449–452. Online at *www.nature.com/nature/journal/v451/n7177/abs/nature06505.html*.

Sánchez-Bayo, F., and K.A.G. Wyckhuys. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* 232:8–27. Online at *https://doi.org/10.1016/j.biocon.2019.01.020*.

Sanderman, J., T. Hengl, and G.J. Fiske. 2017. Soil carbon debt of 12,000 years of human land use. *Proceedings of the National Academy of Sciences* 114(36):9575–9580. doi: 10.1073/pnas.1706103114.

Schaider, L.A., L. Swetschinski, C. Campbell, and R.A. Rudel. 2019. Environmental justice and drinking water quality: Are there socioeconomic disparities in nitrate levels in US drinking water? *Environmental Health* 18(1):3. Online at *https://ehjournal.biomedcentral.com/articles/10.1186/s12940-018-0442-6*.

Schulte, L.A., J. Niemi, M.J. Helmers, M. Liebman, J.G. Arbuckle, D.E. James, R.K. Kolka, J. Neal, G. Van Ryswyk, and C. Witte. 2017. Prairie strips improve biodiversity and the delivery of multiple ecosystem services from corn-soybean croplands. *Proceedings of the National Academy of Sciences* 114(42):11247–11252. Online at *https://doi.org/10.1073/pnas.1620229114*.

Sobota, D.J., J.E. Compton, M.L. McCrackin, and S. Singh. 2015. Cost of reactive nitrogen release from human activities to the environment in the United States. *Environmental Research Letters* 10(2):025006.

Statista. 2019. US population: Do you eat breakfast cereals (cold)? Online at *www.statista.com/statistics/279999/us-households-consumption-of-breakfast-cereals-cold*. Note: statistic based on US census data and Simmons National Consumer Survey.

US Department of Agriculture (USDA). 2018a. *Summary report: 2015 national resources inventory*. Washington, DC: Natural Resources Conservation Service; and Ames, Iowa: Iowa State University Center for Survey Statistics and Methodology. Online at *www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd1422028.pdf*.

US Department of Agriculture (USDA). 2018b. *Small grains 2018 summary*. Washington, DC. Online at *https://downloads.usda.library.cornell.edu/usda-esmis/files/5t34sj573/gq67jv49w/1j92gc06p/smgr0918.pdf*.

United States Global Change Research Program (USGCRP). 2018. *Impacts, risks, and adaptation in the United States: Fourth national climate assessment*. Washington, DC. Online at *https://nca2018.globalchange.gov*.

VandenBygaart, A.J. 2016. The myth that no-till can mitigate global climate change. *Agriculture, Ecosystems and Environment* 216:98–99. Online at *https://doi.org/10.1016/j.agee.2015.09.013*.

Wheater, H., and E. Evans. 2009. Land use, water management, and future flood risk. *Land Use Policy* 26(Supplement 1):S251–S264. Online at *https://doi.org/10.1016/j.landusepol.2009.08.019*.

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