Union of Concerned Scientists

POLICY BRIEF

A CASE FOR A NATIONAL FOOD POLICY

Subsidizing Waste

How Inefficient US Farm Policy Costs Taxpayers, Businesses, and Farmers Billions

HIGHLIGHTS

US food and farm policy involves some 15 federal agencies and departments, and funnels billions of taxpayer dollars into farm subsidies that are often wasteful, with perverse incentives and hidden costs. For example, policies including the Federal Crop Insurance Program limit farmer choices and contribute to serious problems—notably widespread nitrogen pollution of drinking water supplies and coastal waters—that impose health problems in communities and additional billions in water cleanup costs. Multinational agribusiness companies win while local taxpayers, rural residents, water utility ratepayers, and fishing and tourism businesses lose. But scientists have developed cost-effective alternative farming systems, including one that integrates strips of perennial native prairie plants with annual row crops and can help preserve clean water supplies. If adopted across the nation's 12-state Corn Belt, this integrated system would maintain farm productivity while generating more than $850 million per year in net savings to farmers and society from reductions in fertilizer use and surface water runoff.

Today's US food and agriculture system is influenced heavily by taxpayer-funded subsidies and other policies created by Congress and implemented by the US Department of Agriculture (USDA) and more than a dozen other federal agencies and departments (see Box 1, p. 2). These federal policies, along with private investment by agribusiness and the credit system, have helped drive a trend toward ever-larger farms and more industrialized farming practices. The 1970s-era Secretary of Agriculture Earl Butz famously saw larger, more specialized farmers as the key to competing in globalized agricultural markets, and told farmers to "get big or get out." But only a small number of farmers could get big, and many more have since been forced out of agriculture (Marttila-Losure 2012). As a result, today large farms dominate the system (Mulik 2016). And today's federal farm subsidies and other policies push farmers to focus on a few commodity crops, grown in ways that create costly downstream problems that taxpayers and others must clean up. In short, federal farm policies and programs are economically inefficient, spending billions of taxpayer dollars to promote a farming system that ultimately produces poor outcomes for taxpayers, consumers, businesses, and even for most farmers.

Federal Farm Policies Waste Taxpayer Dollars and Shift Costs Downstream

A prime example of such waste and inefficiency is the Federal Crop Insurance Program (FCIP). At one time, farmers growing corn, soybeans, wheat, and other leading commodity crops received government subsidies in the form of direct

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US farmers planted more than 94 million acres of corn in 2016, much of it subsidized by taxpayers through the Federal Crop Insurance Program. About 25 percent of the nation's net farm income in 2016 is expected to come from subsidized federal insurance premiums and payouts.

BOX 1.

Federal Agencies Involved in the US Food And Farm System

As many as 15 federal agencies, independent federal establishments, and commissions play a role in governing and setting the direction of the US food and farming system:

- Consumer Product Safety Commission
- Federal Trade Commission
- US Department of Agriculture
- US Department of Commerce
- US Department of Defense
- US Department of Energy
- US Department of Health and Human Services
- US Department of Homeland Security
- US Department of Housing and Urban Development
- US Department of the Interior
- US Department of Justice
- US Department of Labor
- US Department of Transportation
- US Department of the Treasury
- US Environmental Protection Agency

Among these, the USDA with its 17 sub-agencies is the largest federal entity making policy for the food system. It performs a wide range of functions pertaining to marketing, research, food assistance, dietary recommendations, resource conservation, rural development, and the safety of agricultural commodities. And as this report shows, a number of USDA policies conflict with the mission and policies of the Environmental Protection Agency (EPA), an independent federal agency that works to protect human health and conserve the natural environment. Among other responsibilities, the EPA is charged with protecting the nation's water resources from pollution.

Improved alignment of the missions, policies, and regulations of the USDA, the EPA, and other agencies is critical to a more effective and efficient food system. If adopted and implemented by the next president, a comprehensive reform of our nation's food and farm policies would begin to better align and coordinate these agencies.

payments from the USDA; in 2014, however, Congress eliminated direct payments and shifted farm supports into crop insurance subsidies. While farmers need crop insurance to manage weather-related and other risks, today's FCIP[1] has increased subsidies that benefit narrow corporate interests and the largest landowners. And the price tag of this subsidy program is rising. The latest forecasts from the Congressional Budget Office predict it will cost a total of $22 billion for fiscal years 2016, 2017, and 2018—a 9 percent increase over the previous estimate for those years (National Agricultural Law Center 2016).

About 60 percent of each farmer's annual insurance policy premium is paid by the federal subsidy, accounting for the largest share of FCIP costs. Many observers have argued for abolishing taxpayer-subsidized crop insurance altogether. Even some neutral economists believe it should be reduced to no more than 45 percent (Zulauf and Orden 2014). The current high level of federal subsidy encourages farmers to make decisions based primarily on their ability to collect an indemnity check. In particular, farmers and landowners who bear too little of the risk of farming tend to make planting decisions that lead to poor outcomes for the wider environment (Sumner and Zulauf 2012). And while the USDA has in place so-called "conservation compliance" rules meant to ensure a minimum level of environmental protection in return for federal subsidies, recent reports indicate that compliance is not being fully enforced[2] (OIG 2016).

Farmers and landowners who bear too little of the risk of farming tend to make planting decisions that lead to poor outcomes for the wider environment.

The impact of overly large premium subsidies is evident in today's dominant farming practices. Farmers increased planting of corn and soybeans in 2016, despite the fact that those crops are expected to lose money on every acre because of dramatic price drops in recent years (Bjerga 2016). As a result of combined overproduction and low prices, the USDA estimated that corn and soybean growers will receive some $13.9 billion this year—the biggest crop insurance payouts since 2006 (Bjerga 2016; Schnepf 2016). Indeed, about 25 percent of the nation's net farm income in 2016[3] is expected to come from federal insurance subsidies and insurance payouts (Bjerga 2016).

But the costs of the industrialized, commodity-focused agriculture system our public policies have encouraged go well beyond insurance premium subsidies and payouts. One category of public costs—that posed by agricultural water pollution—literally flows downstream from the farm fields of the dozen states making up the US Corn Belt (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin).

[Large amounts of applied nitrogen can leach through soils, run off fields, and end up in waterways and drinking water supplies.]

Nitrogen Pollution Imposes Heavy Costs on Society

Farmers planted more than 94 million acres of corn in 2016, using vast quantities of nitrogen fertilizers to encourage plant growth, increase yields, and maximize annual profits. Compared with other crops, corn yields are particularly responsive to nitrogen application; and because nitrogen fertilizer is relatively inexpensive, farmers have an economic incentive to apply more (Ribaudo et al. 2011). Whether intentionally or not, federal policies and actions from the agribusiness sector (seed companies, input suppliers, etc.) have had the perverse effect of encouraging overapplication—that is, applying the fertilizers at a rate or time that exceeds the capacity of the crop to use them.

Corn-dominated farming systems also frequently leave soil bare for much of the year. Under such conditions on typical midwestern farms,[4] large amounts of applied nitrogen can leach through soils, run off fields, and end up in waterways and drinking water supplies (David, Drinkwater, and McIssac 2010). Excess nitrogen can also volatilize into the air, further degrading water and air resources. The harmful effects range from ozone damage to crops and forests, acidification and over-enrichment (eutrophication) of aquatic ecosystems, impairment of public drinking water supplies, biodiversity

Current US farm policies encourage the use of vast quantities of fertilizers on crop fields every year. And because nitrogen fertilizer is relatively inexpensive, farmers have a further incentive to apply more than crops can use, putting the nation's water resources at risk from runoff and creating costly problems for taxpayers and others.

losses, visibility-impairing haze, and global warming. Ultimately, much of the cost of these problems is borne by taxpayers and others outside the agriculture sector. A recent nationwide study estimated that nitrogen from agriculture costs Americans $157 billion a year in damages to both human health and the environment (Sobota et al. 2015).

The impacts of nitrogen pollution on the nation's water resources—including contamination of drinking water and damage to inland and coastal waters and the fisheries and recreational opportunities they support—have been well documented (Dubrovsky et al. 2010), and their costs quantified.

Nitrate contamination in drinking water is a growing problem in the United States. It has been linked to a variety of illnesses, including a condition in infants known as blue baby syndrome, various types of cancers[5] (Ward 2009; Ward et al. 2005; Townsend et al. 2003), and inflammatory bowel disease (Roediger 2008; Kolios, Valatas, and Ward 2004; Shah et al. 2004). Although the US Environmental Protection Agency (EPA) has set legal limits on nitrate in drinking water, these limits are commonly exceeded; the number of violations in community water wells nearly doubled from 650 in 1998 to 1,200 in 2008 (State-EPA 2009).

USDA

Fields left bare after harvest, like this one in Iowa, are highly vulnerable to erosion and runoff of fertilizers into streams. Corn-dominated farming systems frequently leave soil bare for much of the year.

BOX 2.

Two US Cities Demonstrate the Downstream Cost of Fertilizer Pollution

Des Moines, Iowa: High nitrate levels in drinking water are a problem across Iowa. According to the Iowa Department of Natural Resources, the water supplies of approximately 260 cities and towns (about 30 percent of the state's 880 water systems) are highly likely to be contaminated with nitrates and other pollutants (Eller 2015).

Perhaps most notably, in 2015 the Des Moines Water Works filed a lawsuit seeking damages from three agricultural counties it says are responsible for agricultural nitrogen pollution. The utility claims it has paid some $1.5 million since 2013 to treat high nitrate levels in water and blames farming and farmland drainage practices in Buena Vista, Calhoun, and Sac counties, which are among the state's top corn-producing counties. The lawsuit further claims this pollution increases water bills for Iowa cities, towns, and their customers by forcing the utility to use expensive removal equipment when nitrate levels peak (as they did in April 2015, when levels in the Raccoon and Des Moines rivers rose above 15 milligrams per liter—50 percent higher than the federal drinking water standard of 10 milligrams per liter). The Des Moines Water Works anticipates the need to build a larger nitrate removal plant in the next few years, at a cost approaching $184 million.

Toledo, Ohio: Toxic cyanobacteria—also called blue-green algae, a type of ancient bacteria with chlorphyll—are a recurring problem in Lake Erie, which supplies drinking water in and around Toledo (among other US and Canadian cities). Lake Erie is the shallowest of the Great Lakes, making it a perfect breeding ground for cyanobacteria, which thrive in warm, shallow waters. The organisms are literally fertilized by phosphorus—like nitrogen, a key component of fertilizers used on midwestern farm fields.

In August 2014, Toledo officials warned residents not to drink or cook with municipal tap water, which tests showed contained potentially dangerous levels of microcystins—toxins produced by blue-green bacteria that can cause nerve and liver damage in people and animals (Arenschield 2014). The 2014 crisis, which ultimately affected more than 500,000 people for an entire weekend, followed a previous episode of contamination in 2011. Toledo has already spent $3 million to treat microcystins in drinking water, and is planning to install a $70 million treatment system in 2016 to better combat these toxins.

Notably, nitrogen has been linked to drinking water contamination in Des Moines, Iowa, and phosphorus (another component of agricultural fertilizers) to drinking water contamination in Toledo, Ohio[6] (see Box 2). These cases are not isolated. In state after state, drinking water supplies are threatened by agricultural pollution. In addition, nitrogen (and phosphorus) that runs downstream from farm fields ends up in coastal waters and the Great Lakes, where it decimates fish and shellfish stocks. Coastal waters including the Gulf of Mexico and the Chesapeake Bay are plagued by hypoxia—a phenomenon in which aquatic ecosystems are deprived of oxygen because of rapid microbial growth due to excess nutrients including nitrogen—with harmful impacts on fish and shellfish. Toxic algae blooms sparked by excess nutrients also cause problems for coastal tourism and recreation.

A number of studies have estimated the costs of nitrogen water pollution borne by various sectors:

- **Costs of treating private drinking water wells.** About 13 million American households get their water from private groundwater wells (US Census Bureau 2013). Between 1991 and 2004, some 2 million private drinking water wells (4.4 percent of such wells) had nitrate levels higher than the EPA-recommended standard for human consumption (DeSimone, Hamilton, and Gilliom 2009).[7] Total treatment costs for nitrate pollution from all sources[8] including agriculture were estimated at $1.12 billion ($1.26 billion in 2016 dollars) (Compton et al. 2011).[9] One 2009 study has estimated that consumers spent $813 million ($1.1 billion in 2016 dollars) each year on bottled water due to nutrient-related taste and odor problems in public water supplies due to eutrophication (Dodds et al. 2009).
- **Public water treatment costs.** Communities faced with nitrate contamination in public drinking water supplies must choose between replacement, treatment, or prevention of contaminated water. Even in cases where nitrate concentrations are below the EPA's drinking water standard (10 mg nitrate per liter of water), nitrate and eutrophication treatment costs of drinking water can be expensive (Cooke and Kennedy 2001). The USDA Economic Research Service (ERS) has estimated the annual cost of removing nitrate from US water supplies exceeds $4.8 billion.[10] Of this, agriculture's share of the costs is about $1.7 billion each year (Ribaudo et. al 2011). The majority of these costs are borne by large utilities due to the volume of water treated. The ERS estimates that reducing nitrate concentrations in source waters by

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Nitrogren fertilizer can run off bare soil, leach into the ground, and end up in waterways and drinking water supplies. Nitrate contamination in drinking water has been linked to various cancers and other health concerns, posing a significant risk to public health.

just 1 percent would reduce water treatment costs by $120 million per year (Ribaudo et. al 2011).

- **Costs of coastal nitrogen pollution borne by local fishing and tourism industries.** In addition, nutrient pollution has multiple and extensive impacts on sectors of the US economy that rely on clean water. The annual average economic costs of algae blooms from 1987 through 2000 on commercial fisheries, coastal tourism, public health, and coastal monitoring and mangement are estimated to be $82 million per year ($101 million in 2016 dollars) (Hoagland and Scatasta 2006). The tourism industry loses close to $1 billion each year, mostly from losses in fishing and boating activities because of nutrient-polluted water bodies (EPA 2012). A recent study estimated the economic costs of targeted conservation efforts within the agricultural sector to improve the water quality of Chesapeake Bay by setting water quality goals and developing watershed improvement plans for the bay states. It found that the cost of implementing agricultural best management practices[11] in these states between 2011 and 2025 would be $3.6 billion (2010 dollars). The annual cost of such practices after 2025 is $900 million (Shortle et al. 2013).
- **Additional health costs of nitrogen pollution.** Several studies have estimated the impact of harmful algae blooms[12] in coastal areas linked to nitrogen. In 2002, a single incident of paralytic shellfish poisoning was estimated to cost $6 million ($8 million in 2016 dollars) (Compton et al. 2011; Hoagland et al. 2002), while the cost of a single outbreak of *Cryptosporidium* in 1993 was $96.2 million ($160 million in 2016 dollars)[13] (Compton et al. 2011; Corso et al. 2003). A recent study estimated that, for each kilogram of nitrogen used in the United States, it costs an average of $23.10 to treat the increased incidence of respiratory disease and $16.10 for increased eutrophication (Sobota et al. 2015). Excess nitrogen in surface waters also can indirectly affect human health,[14] worsening pathogens like West Nile virus, pollen allergens, swimmer's itch, malaria, and cholera (Johnson et al. 2010; Townsend et al. 2003). Finally, a gaseous form of nitrogen, nitrous oxide, is also known to be a predecessor of tropospheric ozone and particulate matter that can increase rates of asthma and other respiratory problems, predominantly in children and other vulnerable populations (Compton et al. 2011; Delucchi 2000).

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Signs warn of toxic algae at an Ohio beach. Algae blooms and nitrate contamination from agricultural runoff close beaches and poison drinking water supplies across the country, threatening public health and imposing costs on taxpayers, water utilities, and fishing and recreation industries.

> ***The responsibility lies with our current system of public agriculture policies, and the subsidies and farming system they have shaped.***

New Farming Systems—and Public Policies to Support Them—Are Needed

Nitrogen pollution from agriculture is not primarily the fault of farmers, and it cannot be solved solely by cutting back on fertilizer application. Rather, the responsibility lies with our current system of public agriculture policies, and the subsidies and farming system they have shaped. Simply put, federal policy incentives encourage systems of farming—in particular, an overreliance on annual crops such as corn that leave soil bare half the year and require nitrogen fertilizers to maximize profits—that cause costly damage to the nation's soil, water, and air resources.[15]

Some agricultural stakeholders have advocated solving the nitrogen problem by encouraging farmers to apply nitrogen fertilizers more precisely. Precision application that increases crop uptake and reduces nitrogen loss, however, will not fully address the problem.[16] Scientists in Iowa have estimated that improved fertilizer management through more precise rates and timing would decrease nitrogen pollution in waterways by approximately 10 percent (Iowa 2013). By contrast, farming systems that incorporate year-round plant cover to protect the soil can reduce nitrogen losses by a much greater percentage, between 42 and 85 percent (Iowa 2013; Leibman et al. 2013).

As achieving these greater benefits will require significant changes by farmers, public policies are needed to support them.

A Practical, Cost-Effective Strategy to Reduce Nitrogen Pollution from Farms

One innovative and cost-effective way public policies could address nitrogen losses from crop fields is by providing incentives and technical assistance for farmers to adopt various practices both within and at the edges of their fields, such as drainage water management, shallow drainage, wetlands, bioreactors, and buffers.[17] Recent research has shown that, among farming changes that reduce nitrogen losses, such practices have the largest pollution reduction potential and require taking the least amount of land out of production (Iowa 2013).

Iowa offers a useful case study. Some 85 percent of the state was once covered with prairies,[18] which with their deep root network contributed to building incredibly fertile soil well suited for crop production. As a result, 70 percent of Iowa's acres are now covered with annual row crops, mostly corn and soybeans. But annual crops do not have the soil-protecting capacity of perennial prairie systems, and thus more than half of the fertile prairie-derived soil carbon across the Midwest has been lost over the last 150 to 200 years since agricultural cultivation began in the state (Huggins et al. 1998). New scientific research suggests the prairie plants that historically covered the US Corn Belt could become a tool for improving water quality in the region and beyond.

Analysis: Costs Savings from Expanding Prairie Strips in Iowa and Beyond

One way to achieve the benefits is to integrate narrow strips of native perennial prairie plants ("prairie strips") with row crops and around the edges of agricultural fields. Researchers at Iowa State University's STRIPS project (Science-based Trials of Rowcrops Integrated with Prairie Strips) have found that strategically positioned prairie strips in and around farmland provide multiple major benefits to farmers and society disproportional to the amount of land converted: the soil and nutrient runoff from nine acres of row crops can be treated with just one acre of perennial prairie. Planting prairie strips on 10 percent of land can reduce nitrogen loss in

Iowa State University researchers have shown that planting a mix of perennial prairie plants in and around experimental crop fields reduces erosion and holds nutrients in the soil. Replacing just 10 percent of cropland with these "prairie strips" can decrease nitrogen loss in surface water runoff by 85 percent, phosphorus loss by 90 percent, and sedimentation by 95 percent.

surface water runoff (rivers and streams) by 85 percent, phosphorus loss by 90 percent, and sedimentation by 95 percent (Helmers et al. 2012). The estimated costs of the prairie strips range from \$25 to \$34[19] per acre (inclusive of opportunity costs such as the cost of foregone rent or net revenue loss due to land converted to prairie), depending on the quality of the land and prairie strip. However, the USDA Conservation Reserve Program (CRP; see Box 3, p. 8) can reduce those costs by more than 80 percent under a 15-year contract, bringing the final cost to farmers to between three and four dollars per crop-acre planted with prairie (Tyndall et al. 2013). When planted on a farm's degraded areas, prairie plants can even rebuild soils over time so that these areas can become profitable again.

We analyzed two scenarios to estimate the extent to which planting prairie strips on a small percentage of land in Iowa and across the Corn Belt could reduce surface water cleanup costs[20] by preventing nitrogen pollution as well as soil erosion and related phosphorus pollution (Tables 1 to 3).

- **Iowa scenario.** In this scenario, we estimated the impact of replacing 10 percent[21] of the corn acreage in Iowa with prairie strips, assuming that the experimentally measured 95 percent reduction in soil erosion scales up to Iowa's total corn acreage of 13.6[22] million acres (National Agricultural Statistics Service 2016). Thus, this scenario envisions 1.36 million acres across the state planted with prairie strips. Such an effort would have economic and physical benefits far greater than the economic loss of those acres to row crops, including:

BOX 3.

Conservation Programs

There are three main programs that promote adoption of environmentally sustainable practices. These are the Conservation Reserve Program, the Conservation Stewardship Program, and the Environmental Quality Incentives Program.

Conservation Reserve Program (CRP): The CRP provides annual rental payments, usually over 10 years, to producers to replace crops on highly erodible and environmentally sensitive land with long-term resource-conserving plantings. Bids to enroll land are solicited during a limited time period, then compared using an Environmental Benefits Index (EBI). Bids with the highest EBI scores are accepted. But the program is being downsized. The 2014 farm bill reduced the enrollment ceiling from 32 million acres to 24 million acres by FY 2018. As of August 2015, there are 655,434 active contracts on 367,552 farms with 24.2 million acres enrolled. The limit to enroll in the CRP at any one time is 25 million acres in FY 2016, and will be reduced to 24 million acres in FY 2017 and FY 2018. The estimated FY 2016 funding is $1.8 billion (based on the estimated number of acres that will be enrolled, including technical assistance).

Conservation Stewardship Program (CSP): The CSP provides financial cost-share and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on tribal and private working lands. Contracts (five years in length with the option of extension) are based on meeting or exceeding a threshold for stewardship as defined by the USDA. Payments are based on the actual costs of installing conservation measures, any income foregone as a result of installing the measures, and the value of the expected environmental outcomes. The program was first open for sign-up in 2009; at the end of FY 2014, over 67 million acres were enrolled. But this program is also decreasing. In the 2014 farm bill, the enrollment cap was reduced from 12.77 million acres annually to 10 million acres annually. The estimated funding for FY 2016 is $1.16 billion limited to 7 million acres (based on the estimated number of acres that will be enrolled, including technical assistance).

Environmental Quality Incentives Program (EQIP): EQIP provides financial and technical assistance to producers and landowners to plant and install structural, vegetative, and land management practices on eligible lands to lessen natural resource problems. EQIP may share up to 75 percent of the costs for conservation practices, or up to 90 percent of project costs for socially disadvantaged, limited-resource, beginning, and veteran farmers and ranchers. Eligible producers enter into contracts to receive payment for carrying out conservation practices. In FY 2014, EQIP obligated over $928 million for 37,207 contracts covering 11.2 million acres. In FY 2014, 37,207 applications were funded (36.7 percent) leaving 64,169 applications unfunded, valued at $1.7 billion. The estimated funding for FY 2016 is $1.65 billion, FY 2017 is $1.65 billion, and FY 2018 is $1.75 billion.

- Reducing soil erosion by 4.84 tons[23] per acre and thereby associated surface water cleanup costs[24] by more than $370 million.
- Saving Iowa farmers[25] more than $90 million in fertilizer costs.[26]
- Benefiting society and farmers between $381 million and $431 million,[27] at a cost to taxpayers of $30 million to $72 million[28]—a return on investment of 6- to 12-fold.

While this example assumes the entire state, prairie strips could be first established in smaller areas that are exceptionally prone to erosion. Moreover, these estimated savings are just from the single state of Iowa, which accounts for 20 percent of the entire Corn Belt corn acreage.

- **Corn Belt scenario.** In this scenario, we envisioned 10 percent of the corn acreage in the entire 12-state Corn Belt planted with prairie strips, assuming a conservative 50 percent[29] reduction in soil erosion. The Corn Belt's total corn acreage is 75.9[30] million acres (National Agricultural Statistics Service 2016). Thus this scenario envisions 7.59 million acres across the region planted with prairie strips. The economic benefits would include:
  - Reducing soil erosion by 1.95 tons[31] per acre and thereby associated surface water cleanup costs[32] by more than $840 million.
  - Saving farmers over $200 million in fertilizer costs.
  - Saving the Corn Belt between $571 million and $854 million,[33] at a cost to taxpayers of $168 million to $403 million—a two- to three-fold return on investment.

It is important to note that elevated nitrate levels cannot be eliminated through modification of a single farming practice (excepting the original fertilizer mismanagement).

TABLE 1. Savings in Water Cleanup and Fertilizer Costs in Iowa and the Corn Belt

	Iowa	Corn Belt
Soil Saved per Acre (tons)	4.845[1]	1.95[2]
Savings in Water Cleanup Costs ($/acre)[3]	$27.57	$11.10
Total Savings in Water Cleanup Costs (billion $)	$0.375[4]	$0.842[5]
Savings in Fertilizer Costs ($/acre)[6]	$6.67	$2.69
Total Savings in Fertilizer Costs (billion $)	$90.8[7]	$203.9[8]
Total Savings (water cleanup + fertilizer costs) (billion $)	$0.466	$1.05

SOURCES:

[1,2,3] Duffy 2012; Cox 2011; NRCS 2009.

[4,5,6,7] Estimated.

NOTES:

[1] Calculated assuming 95 percent reduction in soil erosion and base soil erosion rate of 5.1 tons/acre.

[2] Calculated assuming 50 percent reduction in soil erosion and base soil erosion rate of 3.9 tons/acre.

[3] Calculated using NRCS estimates that for each ton of prevented soil erosion, water cleanup costs are reduced by $5.69/ton (2007 estimate was $4.93/ton; we updated to 2016 dollars).

[4] Estimated by multiplying savings in water cleanup costs per acre by total acres (13.6 million acres).

[5] Estimated by multiplying savings in water cleanup costs per acre by total acres (75.9 million acres).

[6] Estimated using NRCS estimate that each ton of soil eroded contains 2.3 pounds of nitrogen and one pound of phosphorus and using the price of nitrogen as $0.40/lb and the price of phosphorus as $0.45/lb. Calculated as tons of soil saved per acre times fertilizer value per ton of eroded soil.

[7] Estimated by multiplying savings in fertilizer costs per acre by total acres (13.6 million acres).

[8] Estimated by multiplying savings in fertilizer costs per acre by total acres (75.9 million acres).

However, various practices and management systems in combination can dramatically reduce nitrogen pollution, and different systems may be needed in different places. We have focused our analysis on one practice—prairie strips—that has been shown to substantially reduce nitrogen loss from agricultural fields through surface water runoff, and to do so cost-efficiently. However, the vast majority of agricultural nitrogen in Iowa and elsewhere in the Corn Belt moves through subsurface (belowground) flow pathways with much of this through installed subsurface drainage systems, and for prairie strips to be effective for these situations the root zone of the prairie strips would need to interact substantially with this subsurface flow. Therefore, to fully address water pollution, prairie strips would need to be paired with other practices and technologies (such as bioreactors or saturated buffers) to remediate subsurface water pollution. Such a combined management strategy would require additional investment but would further reduce agricultural pollution and increase the associated cost savings in the long run.

Conclusions and Recommendations

Pollution of water resources is a large and growing problem, and much of it is attributable to agriculture. As we have shown, this problem is heavily influenced by the current system of federal farm policies—in particular, subsidized crop

Smarter public policies would help prevent costly problems before they occur.

insurance—that create incentives for overproduction of a few commodity crops in monoculture, enabled through heavy applications of fertilizers. The Federal Crop Insurance Program alone is anticipated to cost taxpayers $22 billion between 2016 and 2018, and the cost estimates just keep rising. As if the direct cost to taxpayers of the crop insurance program weren't enough, this and other USDA programs encourage a form of agriculture that damages critical water resources and sends more costs to taxpayers, water users, and businesses downstream.

Smarter public policies would help prevent costly problems before they occur. Practical, cost-effective farm practices can cut erosion, runoff, and resulting pollution dramatically—by our conservative estimates, achieving more than $850 million in net savings to farmers and society every year.

We recommend that Congress and the next president take the following actions:

TABLE 2. Annual Costs to Taxpayers and Net Benefits of Planting Prairie Strips in Iowa

	Low-Quality Land	Medium-Quality Land	High-Quality Land	Higher Opportunity Costs Scenario*
Costs Per Acre of Prairie Strips Planted[1]	~$25.24	~$30.28	~$34.32	~$63.00
Costs per Acre to Farmers[2]	~$3.00	~$4.00	~$4.00	~$9.38
Costs per Acre to Taxpayers[3]	~$22.21	~$26.24	~$30.28	~$53.15
Total Costs to Taxpayers (million $)[4]	$30.21	$35.69	$41.18	$72.28
Net Benefits to Society (million $)[5]	$344.72	$339.24	$333.74	$302.64
Net Benefits to Society and Farmers[6] (million $)	$431.40	$424.53	$419.05	$380.68

SOURCES:

[1,2] Iowa State University Extension 2015.

[3,4,5,6] Estimated.

NOTES:

[1,2,3] Costs are in 2016 dollars based on average land rent across cropland quality—low, medium, and high—as measured by the land's corn suitability rating (CSR). Two primary components of costs are: establishment costs (site preparation, seeds, and planting) and opportunity costs. On most sites, less than 10 percent of the costs are site preparation and prairie establishment costs while 90 percent are opportunity costs; that is, the cost of foregone rent or net revenue loss due to land converted to prairie. Subsequent-year costs will be reduced (though by a very small portion, since the majority of the costs are opportunity costs) since there will not be establishment costs. Here, we do not show the slightly lower costs in the subsequent year to account for any unforeseen costs (such as replanting of some prairie strips) that may arise in that year.

[4] Estimated cost for converting 1.36 million acres to prairie strips.

[5] Difference between savings in water cleanup costs and costs to taxpayers. Note, since opportunity costs form the main component of the costs of planting prairie strips, land with low CSR (low quality) will have less opportunity costs as farmers/landowners have less to lose (due to less rent foregone/net revenue loss) from taking cropland out of production and planting prairie strips. Further, they may actually gain more from prairie strips due to higher savings from soil erosion. Thus net benefits are higher for low-quality land.

[6] Net benefits to society plus net benefits to farmers (savings in fertilizer costs minus costs to farmers).

* The opportunity costs for planting prairie strips (low to high) are calculated using average land rent as a substitute for foregone revenue. However, in Iowa land rent may be higher than the averages used to estimate costs of planting prairie strips (low to high). Thus costs may be underestimated, and actual costs may exceed $60 per acre per year of every row-crop acre treated with prairie.

- **Reduce federal crop insurance premium subsidies that drive overreliance on corn, soybeans, wheat, and other annual commodity crops.** Today's premium subsidies have a high—and rising—cost to taxpayers, and they encourage farming practices with costly consequences for the nation's critical water resources and water users. Limiting premium subsidies would reduce up-front costs to taxpayers and downstream costs to local communities, residents, and businesses, while leaving a crop insurance program that still helps family farmers when they need it most.

- **Increase funding and technical assistance to encourage on-farm conservation practices, and ensure their adoption as a condition for receiving federal farm subsidies.**
  - ***Increase funding for existing conservation systems.*** The USDA's farm conservation programs—including the Conservation Reserve Program, the Conservation Stewardship Program, and the Environmental Quality Incentives Program—are in high demand from farmers, yet these programs are consistently underfunded and subjected to reductions during the congressional appropriations process. More robust and stable conservation funding is needed to meet the demand from American farmers and to cost-effectively achieve environmental benefits that save Americans money in the long run.
  - ***Improve enforcement of conservation compliance.*** The USDA's conservation compliance provisions currently require farmers and landowners to undertake basic conservation practices as a condition of receiving FCIP crop insurance subsidies and participating in a variety of other subsidy and incentive programs. Yet the provisions apply only to a subset of the most fragile farmlands, and enforcement has been woefully lacking; a recent report from the USDA's Office of the Inspector General (OIG) found that in fiscal year (FY) 2014, $4 billion in USDA payments were made to land in 10 states without compliance review by its Natural Resources Conservation Service (NRCS) (OIG 2016). The USDA

TABLE 3. Annual Costs to Taxpayers and Annual Net Benefits of Planting Prairie Strips in the Corn Belt

	Low-Quality Land	Medium-Quality Land	High-Quality Land	Higher Opportunity Costs Scenario*
Costs Per Acre of Prairie Strips Planted[1]	~$25.24	~$30.28	~$34.32	~$63.00
Costs per Acre to Farmers[2]	~$3.00	~$4.00	~$4.00	~$9.38
Costs per Acre to Taxpayers[3]	~$22.21	~$26.24	~$30.28	~$53.15
Total Costs to Taxpayers (million $)[4]	$168.57	$199.16	$229.82	$403.41
Net Benefits to Society (million $)[5]	$673.57	$642.99	$612.32	$438.74
Net Benefits to Society and Farmers[6] (million $)	$854.53	$816.27	$785.61	$571.50

SOURCES:

[1,2] Iowa State University Extension 2015.

[3,4,5,6] Estimated.

NOTES:

[1,2,3] Costs are in 2016 dollars based on average land rent across cropland quality—low, medium, and high—as measured by the land's corn suitability rating (CSR). Two primary components of costs are: establishment costs (site preparation, seeds, and planting) and opportunity costs. On most sites, less than 10 percent of the costs are site preparation and prairie establishment costs while 90 percent are opportunity costs; that is, the cost of foregone rent or net revenue loss due to land converted to prairie. Subsequent-year costs will be reduced (though by a very small portion, since the majority of the costs are opportunity costs) since there will not be establishment costs. Here, we do not show the slightly lower costs in the subsequent year to account for any unforeseen costs (such as replanting of some prairie strips) that may arise in that year.

[4] Estimated cost for converting 7.59 million acres to prairie strips.

[5] Difference between savings in water cleanup costs and costs to taxpayers. Note, since opportunity costs form the main component of the costs of planting prairie strips, land with low CSR (low quality) will have fewer opportunity costs as farmers/landowners have less to lose (due to less rent foregone/net revenue loss) from taking cropland out of production and planting prairie strips. Further, they may actually gain more from prairie strips due to higher savings from soil erosion. Thus net benefits are higher for low-quality land.

[6] Net benefits to society plus net benefits to farmers (savings in fertilizer costs minus costs to farmers).

* The opportunity costs for planting prairie strips (low to high) are calculated using average land rent as a substitute for foregone revenue. However, in Iowa land rent may be higher than the averages used to estimate costs of planting prairie strips (low to high). Thus costs may be underestimated, and actual costs may exceed $60 per acre per year of every row-crop acre treated with prairie.

should follow the OIG recommendations to prevent further improper payments.

— ***Facilitate the adoption of innovative systems such as prairie strips through USDA conservation programs.*** In order to take up new farming systems, farmers need credible information, outreach, and technical assistance. To take best advantage of the promise of prairie strips, the USDA's NRCS should anticipate the information farmers will need (based on the dozens of Iowa farms that are experimenting with the system) and take steps to communicate that information. In addition, the NRCS should identify prairie strips as an approved conservation practice eligible for technical assistance and incentives.

- **Adopt a comprehensive national food and farm policy that incorporates the above recommendations.** In recent years, federal farm policy has taken some steps toward sustainability. But current programs, such as the Conservation Stewardship Program, are too small to assist most farmers with shifting their practices to prevent problems such as nitrogen pollution and its downstream costs. A more holistic and intentional policy approach is needed. The next president should commit to creating a comprehensive national food policy that would streamline and coordinate existing food, health, environmental, and economic objectives—which are currently under the purview of at least a dozen federal agencies—as a first step toward transforming the nation's food system. By committing to take such a policy approach, the next president can support farmers while reducing agriculture's negative consequences on other sectors and industries, saving taxpayers money, and preserving the natural resources future generations will depend upon. For more information, visit *www.ucsusa.org/plateoftheunion*.

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ENDNOTES

1 *The FCIP is a partnership between the USDA's Risk Management Agency and 18 private insurance companies. It covers commodity crops and other food crops, but the main recipients are corn, soybean, and wheat growers, as those are the three most widely planted crops in the country. The FCIP subsidizes well over half of each farmer's annual premium and underwrites the administrative and operating expenses of the private insurance companies that sell and service the policies, as well as a portion of those companies' losses (O'Connor 2013). Payments from the program cover losses due to poor crop production, weather damage, and low commodity prices.*

2 *A recent USDA Office of the Inspector General (OIG) report found that in FY 2014, $4 billion in Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) payments were made to land in 10 states without review for compliance (OIG 2016).*

3 *Net farm income is projected at $54.9 billion, of which $13.9 billion is projected to be from government payments (Schnepf 2016).*

4 *In much of the northern Corn Belt, crop fields are underlaid with a grid of porous ceramic or plastic tubing that drains excess water from the rooting zone. The technique converts swampland or flood-prone areas into arable land. This subsurface drainage system collects, concentrates, and accelerates delivery of nitrates and other agricultural pollutants directly to surface water bodies, such as drainage ditches, streams, and rivers (David, Drinkwater, and McIssac 2010).*

5 *There is disagreement in the literature regarding some of these linkages (see Powlson et al. 2008).*

6 *Drinking water contamination in Toledo was due to phosphorus pollution.*

7 *Based on a USGS sample of 2,100 wells in 48 states. Nitrate was found in 72 percent of the wells.*

8 *Other major sources of nitrate pollution include septic systems, lawn fertilizers, and domestic animals in residential areas.*

9 *Based on the EPA's cost estimate model that the capital of removing nitrate with ion exchange is $280,000 for a small community water system serving 500 people or $560/person (State–EPA 2009).*

10 *Cost estimates are based on 1996 technologies.*

11 *These are actions that agricultural producers can undertake to reduce the amount of pesticides, fertilizers, animal waste, and other pollutants entering our water resources, and to conserve water supplies.*

12 *There is scientific consensus that degraded water quality from increased nutrient pollution encourages the development and persistence of many harmful algae blooms (HABs) and is one of the causes for their expansion in the United States. Further, the composition–not just the total quantity–of the nutrient pool impacts HABs (Heisler et al 2008).*

13 *$31.7 million ($52.9 million in 2016 dollars) in health costs and $64.6 million ($107.8 million in 2016 dollars) in lost worker productivity (Corso et al. 2003).*

14 *For example through stimulation of HABs that produce toxins (Camargo and Alonso 2006), outbreaks of dangerous pathogens such as* Cryptosporidium, *or just unpleasant odors and tastes that are expensive to eliminate.*

15 *For example, corn only grows for approximately five to six months (April–October in the United States), leaving the soil bare and unprotected the rest of the year unless a winter cover crop is planted. Nitrogen is naturally stored in the organic portion of the soil; when soil temperatures increase and rains move the soil, which occurs in the spring, naturally occurring nitrogen can also be lost through the same pathways as excess nitrogen fertilizer applied by farmers, which also pollutes water and air resources.*

16 *Only about 35 percent of crop acres receiving nitrogen met all three of the nitrogen management criteria of rate, timing, and method. A 2006 USDA survey found that close to two-thirds—65 percent—of corn acres were in need of improved nitrogen management. Since this was based on a 2006 survey (Ribaudo et. al 2011), the actual acres meeting the nitrogen management criteria may have increased or decreased in recent times.*

17 *Other nitrogen reduction strategies include improved nitrogen fertilizer management (timing, source and nitrogen application rate, nitrification inhibitors, cover crops and mulches) and land use (perennials, extended rotations, grazed pastures).*

18 *Prairie is a native ecosystem, composed of plants and other organisms that are well adapted to Iowa's specific climate and soils. Many of these species have declined due to the loss of prairie.*

19 *Opportunity costs can scale higher than the low, medium, and high estimates; costs may be over $60 per year for every row-crop acre treated with prairie.*

20 *Due to data availability, we restrict our analysis to surface water impacts and do not estimate groundwater impacts.*

21 *Ten percent was chosen based on the STRIPS field experiment, which tested the impact of planting prairie strips on 10 percent of land (Helmers et al. 2012).*

22 *Average planted acreage from 2013–2015.*

23 *Using an average soil erosion rate in Iowa of 5.1 tons/acre (Duffy 2012).*

24 *Based on NRCS estimates that each ton of soil erosion saved would reduce water cleanup costs by $4.93 (we updated the 2007 estimate of $4.93/ton to 2016$ $5.69 (Duffy 2012; NRCS 2009).*

25 *In addition, recent research has shown that incorporating prairie in the lowest-yielding portion of the farmland can increase sub-field profitability by 80 percent (Brandes et al. 2016). We estimate only fertilizer savings here. Actual savings to farmers are expected to be greater.*

26 *Based on NRCS estimates that each ton of eroded soil contains 2.32 lb of nitrogen and one pound of phosphorus. Prices for nitrogen and phosphorus are from Plastina 2016.*

27 *Net savings is the net savings to society (savings in water cleanup costs minus costs to taxpayers) and to farmers (savings in fertilizer costs minus costs to farmers).*

28 *The cost to taxpayers depends on the share paid by the CRP contract to farmers to cover the cost of planting prairie strips. Note that given constraints associated with the CRP, it is unlikely that all these costs would be covered by the program, and not all farmers will receive funding.*

29 *We use a conservative estimate of reduction in soil erosion (50 percent) outside Iowa, as the STRIPS experiment and the result of a 95 percent reduction in sedimentation was specific to certain regions in Iowa. It is unclear what the impact would be on other soils outside of Iowa. The impact could be greater, less, or the same as Iowa; we do not know.*

30 *Average plantage acreage from 2013–2015 for the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.*

31 *Using an average soil erosion rate in the Corn Belt of 3.9 tons/acre (Cox, Hug, and Burzelis 2011).*

32 *Based on NRCS estimates that each ton of soil erosion saved would reduce water cleanup costs by $4.93 (this 2007 estimate was $4.93/ton, which, updated to 2016 dollars, is $5.69) (Duffy 2012; NRCS 2009). These estimates are very conservative as most soil erosion estimates include sheet and rill erosion and do not include soil lost from ephemeral gullies (DeLong, Cruse, and Wiener 2015).*

33 *Net savings is the net savings to society (savings in water cleanup costs minus costs to taxpayers) and to farmers (savings in fertilizer costs minus costs to farmers).*

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