TRUE OR FALSE? EVALUATING SOLUTIONS FOR AGRICULTURE AND CLIMATE CHANGE

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INTRODUCTION

For decades, mainstream climate debates, both nationally and internationally, largely ignored agriculture. Now, thankfully, the climate community has woken up to the importance of agriculture and food systems in tackling climate change. At the same time, this new awareness makes it imperative that climate experts who are new to the complexity of food and agriculture systems learn how those systems work and about the drivers that are stimulating food systems change.

Worryingly, some of the ideas for climate action linked to food and agriculture that enjoy the most political and financial support from governments and agribusiness, food and financial firms lack a sound scientific basis and/or ignore underlying economic and social conditions. Too often, the proposals that have the support of private investors and global agribusiness firms fail to get to the root cause of agriculture's greenhouse gas emissions. Worse, they can have unintended negative ecological or social consequences. As a result, the initiatives fail. We can and must do better, collectively. At stake is both our climate and the land, soil, water and biodiversity we need for future food security. Our solutions must protect human and environmental systems holistically.

This short paper challenges some of the most popular of these false solutions to the climate crisis. The paper offers a short overview of the importance of food and agriculture for effective climate action, then simple but important criteria to help assess whether policy proposals are likely to help or hinder progress on climate goals, considering both the need for mitigation and adaptation. Finally, we look at five highly-touted, yet ineffective — even counterproductive — proposals for climate and agriculture that risk setting back real progress on our climate objectives. For each example of a false solution, we offer a true solution as an alternative.

THE COMPLEX RELATIONSHIP OF FOOD, AGRICULTURE AND CLIMATE CHANGE

Food systems are responsible for an estimated one-quarter to more than one-third of all global greenhouse gas (GHG) emissions. The range is accounted for by different definitions of "food system" (e.g., whether the estimate only counts food or also non-food commodities, such as cotton and biofuels).[i] The upper end of the Intergovernmental Panel on Climate Change (IPCC)'s estimates for the share of food systems' GHG as a part of the global total is 37%. That includes agriculture and land use, as well as food and commodity storage, transport, packaging, processing, retail and consumption.[ii]

There are three main sources of GHG produced in food systems: nitrous oxide, methane and carbon dioxide. Nitrous oxide arises primarily from the use of inorganic fertilizers. Agricultural methane is emitted primarily during the production of ruminant animals (mostly cows) and their manure, as well as from food waste. Carbon dioxide in the food system is produced largely from fertilizer production, farm machinery, transportation and storage. While some farming

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systems can sequester carbon, creating a net climate positive, this potential is not automatically realized, nor is it necessarily permanent. Industrialized agricultural systems are particularly energy-intensive and heavily dependent on fossil fuels.

The biggest potential for climate mitigation lies in cutting methane and nitrous oxide. Methane is a particular problem in intensive animal agriculture systems, where large numbers of animals are concentrated (often indoors), with feed brought in from off the farm. These intensive farms, sometimes called factory farms, produce enormous quantities of manure.[iii] Although methane is a small share of the world's total GHG emissions, it combines a powerful greenhouse effect with a rapid rate of dissipation in the atmosphere; together, these qualities make methane the biggest opportunity to prevent overshooting the 1.5° Celsius target. Over a 20-year time period, methane is 80 times more potent than carbon dioxide as a global warming gas. At the same time, methane dissipates relatively quickly in the atmosphere, in 12 years compared to 1,000 years or more for carbon dioxide.. Nitrous oxide is the most potent greenhouse gas: 273 times more powerful than carbon dioxide.[iv] Nitrous oxide lasts over 100 years in the atmosphere before dissipating. Methane reductions buy a little time for the slower abatement of carbon dioxide and nitrous oxide emissions. There is significant scope to cut methane and nitrous oxide emissions without compromising food security, yet the emissions continue to be left largely unregulated in the United States and in most countries around the world, despite their negative impact on global warming.

Real solutions to climate change do not just cut emissions, but also contribute to better land and water management practices, which are vital to protect the land's capacity to adapt to climate change. Already, the need for adaptation is stressing food systems in different parts of the world as temperatures rise and weather events become more extreme. In some places, including North America, more extreme weather events are hitting farm systems that are already coping with eroded soils, depleted ground cover and polluted water systems, not to mention impoverished rural economies. The adaptive capacity of land is multifaceted. It lies in protecting the economic viability of farms, as well as in building and maintaining soil health, the restoration and protection of freshwater quantity and quality, and in promoting biological diversity. In February, the IPCC Working Group II warned of a significant rise in risks and costs to farmers due to climate-related disruptions. The IPCC emphasized the urgent need for governments and societies to make deep investments in climate adaptation.[v]

Important recent findings about agriculture, food systems and climate change highlighted by the IPCC include:

- Agricultural emissions from methane and nitrous oxide are estimated to have averaged 4.2 billion tonnes and 1.1 billion tonnes of CO_2-eq (carbon dioxide equivalent) respectively each year between 2010 and 2019; they are projected to increase (WGIII).[vi]
- Agriculture "cannot fully compensate for delayed action in other sectors" — in other words, there is no path to "net zero" relying on agriculture alone to provide a sink for other sectors (WGIII).[vii]
- Climate change itself is diminishing the land's existing capacity to absorb carbon from the atmosphere (WGI)[viii] — in other words, we are confronting a moving (and shrinking) target.
- The food sector is the dominant source of GHG at the household level at all levels of income; it is bigger than energy use (WGIII).[ix]
- In 2021, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and IPCC found that the "mutual reinforcing of climate change and biodiversity loss means that satisfactorily resolving either issue requires consideration of the other."

Understanding the need to cut emissions from agricultural systems while protecting (and restoring) their capacity for adaptation, farmers and scientists have been experimenting with agroecological and regenerative approaches to farming and cultivation. These approaches seek to protect future food productionve capacity and to restore damaged land and waterways while maximizing food yields focused on landscapes and diverse foods rather than maximizing individual crop yields. These approaches offer multiple benefits, including more resilient farm income, ecosystem restoration, healthier soils, cleaner water, improved wildlife habitat, and increased capacity to withstand extreme weather. Crucially, they also reduce GHG emissions.

U.S. agriculture and climate change

According to the U.S. Environmental Protection Agency (EPA), in 2020, U.S. agriculture was responsible for just under 10% of total U.S. GHG emissions.[x] Methane emissions from enteric fermentation (burps from ruminants, especially beef and dairy cattle) and animal manure are responsible for 36% of total methane emissions in the U.S. According to the EPA, the largest source of nitrous oxide emissions in U.S. agriculture came from fertilizer application and other practices intended to increase the nitrogen available in the soil. Among the sources of GHG not counted within the agriculture sector by EPA are those associated with fossil fuels used for tractors or trucks, on-farm energy for drying and storing crops, nitrogen fertilizer production, and as well as the emissions associated with farmland loss, all of which are categorized in other chapters of the U.S. GHG inventory.

DISTINGUISHING TRUE FROM FALSE SOLUTIONS

What is a "false solution?" A chemist's answer

In chemistry, a "true solution" refers to solutions with elements that mix to form an indistinguishable liquid. You cannot see the different elements, nor filter them out. In contrast, a false solution — what chemists more often call a "suspension" — still shows its component parts. For example, oil mixed with water creates a suspension rather than a solution. Advocates for climate action are wary of what they call "false solutions." Although they may not have been thinking of the literal chemistry meaning when they chose the label, the analogy is striking. False solutions typically focus on just one or two dimensions of a complex challenge; they ignore the rest, even at the cost of undermining our broader objectives for climate and biodiversity. False solutions remained suspended (or isolated) in the larger systems in which they operate rather than integrating with true solutions to leverage real change.

What is a true climate solution?

A true climate solution contributes to an integrated effort to reduce total GHG emissions and restore eroded agricultural systems while protecting the planet's adaptive capacity to cope with the changes caused by climate change that is already in progress.

True solutions that combine sufficient food production with climate ambition exist. Rapid cuts to GHG from agriculture are possible and necessary, as the three reports published by different IPCC working groups in the past year have made clear. We urgently need to invest in proven and effective remedies to pollution generated by wasteful practices and the externalization of environmental costs. Calls for public funds to underwrite untested innovations and experiments are a risky distraction from the task at hand.

How to tell the difference?

IATP proposes a few criteria to help distinguish true from false solutions.

A false solution includes:

a. Actions that only tweak a few elements of the system, leaving overall climate polluting effects unchanged and distracting from efforts to make real cuts in emissions.

b. Actions that cause net harm, either by reducing emissions of one GHG but increasing emissions of others, or by reducing a system's adaptive capacity. For example, a false solution might harm biological diversity or make unsustainable demands on energy or freshwater supplies.

c. Actions whose promised gains occur far enough in the future to be uncertain and prone to additional delays, occurring at the expense of actions that would take more immediate effect.

d. Actions whose costs (and risks) will be borne by those without political or economic power, and/or whose voices have not been heard in developing the proposal.

In contrast, a true solution includes:

a. Actions that cut total global emissions.

b. Actions that are effective within a short timeframe of a few years.

c. Actions whose full costs fall on the emitters of GHG.

d. Actions that can be independently measured at reasonable cost.

e. Actions that are supported by the communities most directly affected by the change.

f. Actions that help build resilience and adaptive capacity, for example to withstand drought or floods, or to reduce dependence on pesticides and herbicides.

Another way to think about true versus false solutions is to work through a few questions:

- Is there an already existing, simpler and more effective solution?
- Who will pay for the disruption this technology or policy change will cause?
- How soon will the benefits become apparent?
- Will the climate benefits come at the expense of vulnerable communities?

FIVE FALSE SOLUTIONS EXPLAINED

The following five false solutions are often proposed by agribusiness as useful responses in the agriculture sector to the climate crisis. The list is not exhaustive but illustrates why it is important to sift false from true solutions. They are all supported by policies in the U.S., but they are not unique to this country.

1. Factory farm gas (biogas)

Factory farm gas, often branded as biogas or renewable natural gas, has emerged over the last decade as a way to reduce methane emissions by capturing the large amounts of concentrated gas produced in factory-farmed animal systems. Animal factory farms create significant environmental problems for local communities and are disproportionately sited in predominantly Black, Indigenous and people of color communities.[xi] The factory farms generate huge quantities of manure, which is captured in giant pits.

Digesters capture methane from the manure pits and create factory farm gas. In 2000, there were just 25 digesters in operation in the U.S.; by 2021, the EPA counted 317.[xii] While the use of digesters has grown, agriculture methane emissions have risen steadily by nearly 7% during that period.[xiii] The biogas system that has emerged is highly controversial and highly subsidized. For example, California spent $68 million in subsidies for digesters in 2019.[xiv] The subsidies come through a mishmash of state and federal policies; combined, they effectively encourage the expansion of factory farms, increasing the pollution faced by rural communities where the factory farms are located.

Methane digesters are enormously expensive, costing an estimated $4.2 million for a 2,000 dairy cow operation.[xv] This means only the largest operations can afford them, and even then, only with substantial financial help from the government. A major driver of factory farm gas expansion is California's Low Carbon Fuel Standard (LCFS), which was first established in 2011 and now generates just over 800,000 biogas credits per quarter.[xvi,xvii] Factory farm gas operations in other states sell credits into the California market, from as far away as New York,[xviii] often partnering with fossil fuel companies like Shell Oil to feed into natural gas pipelines.[xix] Global hog giant Smithfield benefits from a North Carolina state requirement that 0.2% of the state's renewable energy come from hog waste by 2023,[xx] even as its operations in Utah and Missouri tap into credits from California's LCFS.[xxi] At the federal level, the national Renewable Fuel Standard (RFS) allows factory farm gas producers to create Renewable Identification Numbers (RIN) credits (similar to California's LCFS) and sell them to fossil fuel providers who use them to meet their obligations under the RFS. This currently accounts for some 36 billion gallons of factory farm gas per year, which represents between 6-7% of the market.[xxii]

There is emerging evidence that the rising market for factory farm gas created by state and federal policies is also fueling consolidation in the already concentrated dairy industry. "Milk has become a by-product of manure production," reports the industry publication Hoard's Dairyman.[xxiii] Research by the Union of Concerned Scientists (UCS) earlier this year confirmed that subsidies for factory farm gas gave major advantages to large dairies over smaller dairies, creating incentives to either consolidate production or add cows to existing dairies.[xxiv] In Iowa, after a 2021 bill allowed dairies to expand beyond the current 6,000 cow limit if they use a digester, seven operations immediately expanded their dairy cow operations.[xxv]

Pipelines linked to factory farm gas are a risk to rural communities. Leakage from biogas facilities and pipelines is estimated at up to 15% of total biogas production.[xxvi] For rural residents, methane digesters and associated pipelines can leak and cause fires.[xxvii] Chronic pipeline leakages and ruptures are a major source of methane emissions.[xxviii] The giant factory farm manure lagoons required for digesters are vulnerable to extreme weather events and equipment breakdowns. When these occur, they result in manure spills[xxix] and water pollution.[xxx]

On what other grounds is biogas a false solution? First, the source of the gas: Factory farms. Around the country, rural communities have been fighting factory farms for the way they pollute the water and air where they are sited, lower property values, undermine good health and quality of life, treat animals inhumanely and undermine the economic viability of independent farmers. Advocates in many states, including Iowa, Maryland, Minnesota, Wisconsin and Oregon, have called for moratoriums on new factory farms. A 2019 national poll found that 80% of people are concerned about air, water and health issues from concentrated animal feeding operations (CAFOs), where hundreds or thousands of animals are confined, feed is brought in and large amounts of manure are stored.[xxxi] North Carolina environmental justice advocates have opposed the use of digesters on hog farms that are already polluting largely Black and Latinx rural communities.[xxxii] In early 2022, the EPA launched a civil rights investigation into whether the North Carolina Department of Environmental Quality violated the civil rights of rural residents when they approved four digesters for hog operations.[xxxiii]

Second, while the digester captures some methane, it can increase the amount of ammonia,[xxxiv] nitrate and nitrite (all forms of nitrogen) in the manure. The result leaves more concentrated ammonia and other forms of nitrogen in the leftover manure, which is then sprayed on neighboring fields. Nitrate pollution leads to algae blooms in waterways. Ammonia air pollution is associated with respiratory issues. A National Academy of Sciences study attributes 95 and 83 premature deaths in two counties with a high concentration of hog factory farms to fine particulate pollution, resulting from ammonia emissions.[xxxv] When ammonia oxidizes, it creates nitrous oxide, another potent greenhouse gas.

True Solution: Limit overproduction, regulate emissions. When it comes to dairy and pork, the U.S. has long exceeded its production needs — nearly all new production is geared toward export. There are economic, environmental and climate costs to this overproduction. The National Family Farm Coalition and the Dairy Together campaign are each proposing a variation of dairy supply management as an alternative animal agriculture system that would create economic incentives for lower, more managed levels of production overall, and smaller and mid-sized dairies (which greatly reduce manure-related emissions). The EPA has the authority under the Clean Air Act to regulate methane emissions from large-scale dairy and hog operations, as called for by environmental justice, climate and family farm groups. The California state government and the EPA should stop categorizing factory farm gas as "renewable" and end its eligibility for renewable fuel subsidy programs. Bigger investments should be made in programs that support farmers who are transitioning out of factory farming animals, such as the Alternative Manure Management Program in California. Another program to explore is the voluntary buyout program for factory farm owners outlined in Senator Cory Booker's Farm Systems Reform Act.

2. Soil carbon offset credits

The establishment of both compliance (like California) and voluntary carbon markets to address climate change and reduce greenhouse gas emissions include an option for polluters called offsets. Within a carbon market, a polluter can purchase an amount of carbon sequestered in the soil from a farmer or forest owner (or third-party aggregator) to compensate for an equivalent amount of its own emissions. To date, however, carbon offset credits have proven a spectacular failure, both for farmers and for efforts to reduce total GHG emissions because they enable polluters to continue polluting while claiming climate action.

Certain agroecological systems and practices can sequester carbon in the soil. This property of good farming practice has made soil carbon offsets very popular with companies such as Microsoft, McDonald's, JBS and Tyson Foods. The firms have declared net zero targets based on soil carbon offset proposals. (Net zero emissions mean the company's emissions do not exceed the emissions it removes, or pays to have removed, from the atmosphere.)

But scientists have not yet answered important questions about how much carbon can be sequestered in soil, and for how long. The latest IPCC report concluded that there is not a one-to-one relationship between precisely measured industrial sources of emissions and less scientifically certain (and less permanent) land-based carbon sequestration, including farmland sequestration. The scientists found that climate change itself, through rising temperatures and the increasing frequency of extreme weather events, will slow or disrupt the soil's ability to sequester carbon on farms and forests over time.[xxxvi] An emerging body of research is highlighting the complexities of measuring soil carbon in the short and long term, and some researchers question whether significant additional soil carbon sequestration is even possible.[xxxvii] An analysis of soil carbon testing found that such testing typically overestimates the level of sequestration by sampling too close to the surface.[xxxviii] Other research questions whether carbon can be stored in the upper levels of soil for any significant length of time.[xxxix] A study in Nature found that rising temperatures predicted by climate change will release carbon much faster than previously predicted, thereby unraveling previous sequestration.[xl] The U.S. has already seen extreme weather events literally burn through forest-based carbon offset sites.[xli]

Despite these uncertainties, policymakers, private carbon consultants and project developers have led an effort to establish soil carbon offset credits, both within government-led so-called "compliance" carbon markets and in voluntary private markets.[xlii] Characterized as a carbon credit "wild west," a slew of private carbon markets and offset credit protocols have emerged in the U.S. They all have different rules, obligations, costs and prices. An assessment by CarbonPlan of 14 soil carbon credit protocols in the U.S. concluded that "the lack of rigorous standards makes it hard to ensure good climate outcomes."[xliii] A 2021 Congressional Research Service (CRS) report on agriculture carbon credits within private markets identified five areas that threaten to undermine their credibility: realness (accurate measurement), additionality (action beyond what was planned), leakage, permanence and verification.[xliv] These issues raise questions about whether agriculture carbon credits in private markets are actually reducing emissions at all, reports CRS.

The poor performance of compliance carbon markets in California and in the Northeast states to effectively reduce emissions has led to growing criticism.[xlv] In February, a California state panel reported that the state would badly miss its goal of reducing emissions by 40% below 1990 levels by 2030, largely because of the state's cap and trade system (which includes much more than soil carbon credits).[xlvi] The panel found that polluters have banked millions of carbon credits, many of them forestry-based offsets, allowing them to evade pollution reduction requirements.

The sharpest criticisms of carbon markets in the U.S. come from the environmental justice community. Many sources of greenhouse gas pollution also emit other types of toxic air pollutants that affect human health. Many of the sources of that pollution are located in communities of color.[xlvii] Critics such as the Climate Justice Alliance (connecting frontline communities working for a just transition), argue that offset credits allow companies off the hook from reducing their own pollution and associated damage to public health.[xlviii,xlix]

From the perspective of many U.S. farmers, there are fundamental flaws to the proposed offset credit schemes that make them unpopular. These flaws are many and varied. Carbon credit prices are not high enough to cover upfront costs to the farmer.[l] These high costs, which include the introduction of new land practices, finding new markets, and the cost to measure, verify, report and accredit soil carbon, put offset credits out of reach for all but the larger-scale operators. This creates yet more advantages for further landownership concentration and disadvantages farmers working on rented land. The schemes offer no compensation to the farmers who have already invested in building healthy soils, for example, by following organic practices, and whose soil is already rich in carbon. The length of offset credit contracts also limits farmers' ability to respond to disasters, such as a drought, flood, price collapse or pest infestation. Soil carbon sequestration requires farmers to share significant amounts of data with corporations about what is happening on their farm, including annual information about planting, seeds, fertilizer, equipment and harvest volumes.[li] There are no clear rules governing the use and ownership of this data.

True Solution: Expand and improve conservation programs. There are existing, well-established U.S. land conservation programs that have been proven to offer immediate climate, environmental and economic benefits for farmers, without supporting polluter greenwashing through a carbon credit system. These programs are enormously popular among farmers, but currently only 31% of farmers who apply to the Environmental Quality Incentives Program and 41% of farmers applying to the Conservation Stewardship Program are accepted into the programs.[lii] These programs are designed to be accessible to farmers of all sizes and types. The U.S. government can expand and improve these programs that already support a host of regenerative and agroecological practices and farming systems. This would immediately help reduce emissions and strengthen adaptive capacity, including through better protection for on-farm biodiversity.

3. No-till agriculture

No-till farming practices are a valuable tool to slow soil erosion and conserve water. They have also been touted as a useful tool for carbon sequestration. By not tilling the soil, any carbon sequestered in the soil is left undisturbed and can accumulate. Emerging research, however, is raising questions about the touted carbon sequestration benefits and has identified negative environmental outcomes from the use of no-till practices in isolation.

The USDA reports that approximately 26% of crop acres are under no-till production. These numbers are self-reported by farmers, and there are no specific standards or commonly understood definitions that distinguish a set of practices as "no-till." In fact, many farmers who claim to be practicing no-till do still till in some years.[liii] A USDA study found that only 20% of acres that farmers claimed were managed with no-till practices had not actually been tilled in four years.[liv] Climate change is itself a pressure on no-till farmers: Extreme weather such as flooding can pressure farmers to use tillage to prepare their fields. Moreover, without tilling as a tool for weed suppression, no-till practices have been closely tied to the use of powerful herbicides, such as glyphosate. The emergence of superweeds resistant to glyphosate (and similar herbicides) is another push for farmers to return to tilling.[lv]

Periodic tilling instantly releases significant carbon from the soil.[lvi] But the carbon sequestration benefits of no-till alone are questionable. A recent meta-analysis of the published research found that while some soil organic carbon is gained toward the surface of the soil, some is lost in deeper soil layers resulting in a net loss of carbon for up to 14 years.[lvii] Other research found that there is no difference in the amount of carbon in no-till soils compared to soils subjected to full tillage, and that differences in soil organic carbon (SOC) from the surface to the subsoil below the plow layer can be explained instead by compaction and redistribution of SOC.[lviii] An analysis of the soil carbon sequestration benefits of no-till in Nature[lix] found that no till can sequester carbon under some soil and climactic conditions, but that the uncertainties are so large that the practice is better considered as a tool to adapt to climate change through building soil health rather than a way to mitigate climate change. Another study looking at Midwest farms found that no-till without cover crops, forages or small grains provided much less SOC than previously thought.[lx]

No-till practices alone, particularly coupled with high use of chemicals such as glyphosate that are associated with genetically modified crops, have been linked to other negative environmental outcomes. Because of the associated heavy use of chemicals, over the long-term, no-till can actually increase nitrate and dissolved phosphorous concentration, pesticide runoff (and, with it, water pollution) and nitrous oxide emissions from the soil.[lxi] No-till in a conventional corn and soy rotation production system relies heavily on the application of toxic herbicides to control weeds. The heavy use of glyphosate on U.S. farms, including in no-till systems, has resulted in widespread weeds that are resistant to glyphosate.[lxii] As glyphosate has diminished in effectiveness, some farmers have turned toward dicamba, a more toxic herbicide that has caused enormous harm to neighboring farms as the chemical drifts off target.[lxiii]

True Solution: Beyond no till, integrating practices within an agroecological system. No-till practices are valuable but need to be integrated into regenerative, agroecological production systems, which include longer and more diverse crop rotations, the integration of cover crops and the inclusion of livestock. These integrated systems can manage pests and crop disease with fewer chemicals and build soil health as a bulwark for climate resilience. Expanding and improving U.S. conservation programs can support farmers making this transition.

4. Precision agriculture and big data

Agribusiness firms have touted precision agriculture and big data as a way to reduce production costs and environmental harm by improving farmers' ability to target the right seeds and appropriate inputs on each part of their land, including better targeting of applications of nitrogen fertilizer. Fertilizer use, particularly the use of nitrogen fertilizer used commonly for major crops like corn, is the biggest source of GHG emissions in the U.S. agriculture sector.[lxiv] Over the last decade, the digital revolution has transformed the use of on-farm data and the tools that capture it, including technology in tractors and apps for smartphones. Much of that data is owned and controlled by input supply companies, such as Bayer or Syngenta.

The U.S. government has had the objective to reduce excess use of high emitting fertilizers for several decades, motivated primarily by public concerns over water pollution. Excess fertilizer run-off plays a central role in the creation of "Dead Zones" (an area of low to no oxygen that kills marine life) in the Gulf of Mexico[lxv] and in the Chesapeake Bay.[lxvi] The EPA first acknowledged the challenge of fertilizer-based pollution almost 50 years ago, in 1973.[lxvii] Climate change has added new urgency to the policy objective of reducing fertilizer use in U.S. agriculture, especially as so much of that fertilizer is wasted.

Yet despite the promises of precision agriculture technologies and data management tied to tractors designed to reduce fertilizer use, the production and use of nitrogen fertilizer in the U.S. continues to rise,[lxviii] following trends in place since the 1960s. This use is tied to the steady expansion of U.S. corn acreage, as corn production depends on significant amounts of nitrogen.[lxix, lxx] Runoff into waterways from the excessive use of nitrogen fertilizer is estimated from 10%[lxxi] to 20% of applications.[lxxii] Recent USDA research found fertilizer rates for nitrogen and phosphorous rose in 10 major hog producing states, linked to the use of corn for feed.[lxxiii] Approximately one-third of fertilizer applied to grow corn is compensating for losses in soil fertility, which in turn are a result of corn produced in a monocropping system.[lxxiv] Air pollution associated with expanded corn product and associated fertilizer use has been linked to premature deaths in high-corn-producing states.[lxxv] Even as farmers surrender their on-farm data to global input companies in the quest for efficiencies, any improvements (if they are there) appear to be overwhelmed by an industrial system that demands more corn and more fertilizer.

The production of nitrogen fertilizer requires a high pressure and high temperature environment, which manufacturers create using methane-emitting natural gas. Most U.S. production takes place along natural gas corridors in the South, in Louisiana, Oklahoma and Texas. Cornell researchers recently estimated that methane emissions from fertilizer plants are 100 times higher than previously thought.[lxxvi] Fertilizer plants are prone to explosion,[lxxvii] and the piping of nitrogen can also be dangerous. Mining to produce phosphate, another type of fertilizer, has also been destructive for the local communities, many of which are in the U.S. South.[lxxviii]

The Russian invasion of Ukraine in February 2022 has driven fertilizer prices to all-time highs,[lxxix] due to the disruption of natural gas and fertilizer exports from that region, and to highly concentrated markets. The rise in prices has prompted calls to expand U.S. fertilizer production and for increased investments in precision agriculture tools. But neither of these policies will disrupt industrial production models and their associated pollution and waste. Neither policy will support a transition away from relying on inputs that create heavy environmental externalities. These inputs are also expensive inputs for farmers.

True Solution: Agroecological approaches. A true solution to both the unsustainability of nitrogen fertilizer and its rapidly rising cost is to pursue agroecological approaches that build soil health through planting nitrogen-fixing crops such as legumes and diversifying the crop rotation. These approaches offer a major opportunity to reduce the need for polluting synthetic fertilizers, decrease GHG emissions and strengthen climate resilience at the same time.[lxxx] Here again, expanding and improving conservation programs can help farmers make this transition. Stronger regulation of methane emissions from fertilizer plant production can also bring immediate mitigation benefits.

5. Biofuels

When the Renewable Fuels Standard (RFS) was first passed in 2007, biofuels were touted as offering a perfect "fly-wheel" for agricultural markets plagued by over-supply and low prices. Biofuels would absorb otherwise unwanted corn and soybeans by turning them into a lower-carbon alternative to fossil fuels. Proponents promised an eventual transition away from first order corn-based ethanol toward cellulosic biofuels based on perennial grasses. Farmer-owned biofuel refinery co-ops also promised to bring economic benefits to rural communities.

Two decades later, corn-based ethanol dominates the biofuels market, many of the farmer-owned co-ops have sold out to larger companies, and despite a recent bump, oversupply and prices below the cost of production continue to plague agricultural markets. The environmental benefits touted two decades ago have not materialized. The production of corn-based ethanol has instead worsened environmental outcomes, in part by locking in and expanding corn acres in a production system that is heavily reliant on high-emitting nitrogen fertilizers (see above). Since the RFS passed, corn acreage has expanded by 8.7%, pushing an expansion in other cropland by 2.1%. As farmers planted more corn, they reduced the number of crops in their rotation, driving an increase in annual fertilizer use between 3-8% per year. Almost 40% of corn grown in the U.S. goes to produce ethanol and an ethanol byproduct called dried distillers grains (DDGs), which is used for animal feed.[lxxxi]

There are indications that corn ethanol is now driving negative environmental outcomes. A recent analysis found that when considering all the elements of corn ethanol production, including its impact on the landscape and its heavy reliance on applications of nitrogen fertilizer, corn's carbon intensity (GHGs per gallon of fuel to produce) is likely to be higher than that of fossil fuels.[lxxxii]

As pointed out by University of Minnesota economist Jason Hill, the policy environment today is vastly different than in 2007.[lxxxiii] The U.S. is now a net fuel exporter, not importer. The promise of next generation cellulosic ethanol has died a quiet death. Electric vehicles are rapidly growing their share of the market. Not least, the climate crisis is more apparent and more urgent, increasing the urgency of calls for a transition to more resilient crop systems. Demand for biofuel has pushed corn production on highly marginal lands, expanding the associated water pollution, reducing biodiversity and crowding out more diverse, food-based production systems.

There are now concerns that the rapid transition towards electric vehicles will weaken the ethanol market and send corn prices plunging. Recent research estimates that the price of corn could drop by 50% as electric vehicles come to dominate the market (which could happen as soon as 2030).[lxxxiv]

True Solution: Fewer, more efficient internal combustion engines and less corn. Instead of creating subsidies for crops grown in emissions-intensive systems, an energy and transportation transition should be coupled with an expansion of programs that take marginal farmland out of production and encourage a greater diversity of crops grown within agroecological systems.

NEXT STEPS

Policy choices over the last several decades have shaped the food system we have in the U.S. The existential threat of the climate crisis requires new thinking and a new direction. Food systems are both large sources of GHG emissions and front-line shock absorbers for adaptation. That means policymakers must be clear about sources of emissions and target reductions directly on those sources. At the same time, it means investing in the expansion of agroecological food and agriculture systems that pollute less and build the resilience needed for adaptation. The good news is that there are immediate opportunities to do both.

The 2023 Farm Bill will set agriculture policy in the U.S. for the next five years and is a critical chance to invest in true solutions. These solutions include the already popular and over-subscribed conservation programs. We also need new incentives for agroecological practices through deep reforms to crop insurance and farm credit. Currently, the Farm Credit Administration is alone among federal financial regulators in having no plan to factor climate change into its credit risk framework, creating a significant risk to the viability of future farm credit. In addition to Farm Bill opportunities, there are openings to advance true solutions at the Securities and Exchange Commission (SEC) and the EPA. This year, the SEC is at last proposing that corporations, including agribusiness, be required to document their climate risk. The EPA could also begin the process to regulate methane emissions from the largest, highest-emitting dairy and hog CAFOs.

Like any other sector facing pressure to transform operations and cut greenhouse gas emissions, agribusiness has fiercely resisted change. First, they denied the need for action. More recently, they have gotten behind policies that have a high degree of uncertainty or that protect the bottom line while kicking the need for effective change down the road. Such policies either make no net difference to greenhouse gas emissions, or worse, increase them. That is the problem at the heart of false solutions. We have alternatives that are both proven and effective. It is these true solutions that need public support and investment.

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