



Out to Pasture

REPAIR RESTRICTIONS LEAD TO TRACTOR DOWNTIME
AND HIGH COSTS. RIGHT TO REPAIR WOULD HELP.

U.S. PIRG
Education Fund

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With public debate around important issues often dominated by special interests pursuing their own narrow agendas, U.S. PIRG Education Fund offers an independent voice that works on behalf of the public interest. U.S. PIRG Education Fund, a 501(c)(3) organization, works to protect consumers and promote good government. We investigate problems, craft solutions, educate the public, and offer meaningful opportunities for civic participation.

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Executive Summary

IF A FARMER'S equipment breaks down at the wrong time and they can't get it fixed, farmers can be forced to watch as their crop—and their profits—wither on the vine. Manufacturer-imposed repair restrictions can turn a tractor or combine breakdown into weeks or months of equipment downtime, which can lead to crop losses as tight planting and harvesting windows close or harsh weather threatens.

Prior U.S. PIRG Education Fund research has demonstrated how modern farm equipment has been engineered to limit repair choices. Farmers and independent mechanics cannot access the software they need to comprehensively diagnose and troubleshoot tractors, nor can they install the embedded software necessary to electronically pair replacement parts to a

machine—a process necessary to complete many repairs.¹ As a result, they need to wait for a dealer to perform these functions. Delays and equipment downtime ensue.²

U.S. PIRG Education Fund and National Farmers Union surveyed 53 farmers across 14 states to compare the repair costs, labor hours and downtime that results from breakdowns that farmers fix themselves versus those that an independent or dealer mechanic performs. The model we created from this data found that the group loses an average of \$3,348 per year to downtime caused by repair restrictions.

If all U.S. farmers experience similar losses, that would mean the downtime resulting from repair restrictions is costing American producers more than \$3 billion each year.

Tractor downtime from repair restrictions costs U.S. farmers

\$3 BILLION PER YEAR



Manufacturer-imposed repair restrictions can turn a tractor breakdown into **weeks or months of equipment downtime**, which can lead to crop losses as tight planting and harvesting windows close or harsh weather threatens. That downtime costs U.S. farmers \$3 billion a year.

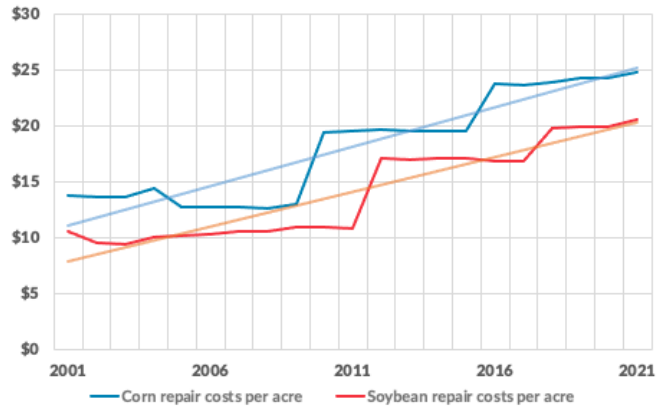
At the same time, the cost of repair is increasing. Analysis of U.S. Department of Agriculture (USDA) data shows that farmers' repair costs have nearly doubled over the past two decades for soybeans and corn, two commonly grown crops. These increases coincide with the trend of increasing amounts of software and software-linked parts in farm equipment—a major mechanism through which manufacturers restrict independent repair.

Right to Repair reforms—which would require equipment manufacturers to provide farmers and independent repair technicians with access to the necessary repair parts, tools, software and documentation on fair and reasonable terms³—would provide farmers with the repair choices they need to ensure that they can fix their equipment as soon as possible.

It would also help drive down repair costs. Surveyed farmers report that dealer mechanics charge an average of \$58.90 more

per hour of labor than independent mechanics. The higher dealer labor rates cost our sample an average of \$1,328 per year.

FIGURE ES-1. REPAIR COSTS INCREASE IN 2000s



Assuming other U.S. farmers experience the same increased rates, repair restrictions are costing them \$1.2 billion dollars annually.

That means Right to Repair could save farmers a resounding \$4.2 billion each year.

Increased labor costs from repair restrictions cost U.S. farmers

\$1.2 BILLION PER YEAR



Farmers are also dealing with many other challenges. Drought-stricken fields get in the way of cultivating crops.⁴ Market consolidation among fertilizer⁵ and seed⁶ suppliers is driving up costs. Supply chain disruptions from COVID-19 continue to make it hard to source needed equipment parts.⁷

At the same time, Americans are spending more to fill their grocery carts. Even as economy-wide inflation slowly eases, food prices remain high. Store-bought food cost 11.3% more in January 2023 than in January 2022; restaurant purchases were 8.2% more expensive over the same period of time.⁸

As lawmakers and regulators consider steps to stabilize prices and provide farmers with needed support, they should take the following action to provide farmers with the repair relief they need to maintain their livelihoods and maximize the amount of their crop that ends up on grocery store shelves.

State and federal lawmakers should pass model agricultural Right to Repair legislation, such as Sen. Jon Tester's Agricultural Right to Repair Act⁹ or the bills Missouri, Colorado and thirteen other states are considering in 2023.¹⁰

Federal lawmakers should pass legislation like the Freedom to Repair Act of 2022,¹¹ which would reform copyright law that unintentionally outlaws many repairs. Such changes would legalize making and selling certain repair tools and enable farmers to electronically pair aftermarket parts to their equipment.

The Environmental Protection Agency (EPA) should investigate John Deere for appearing to violate the Clean Air Act requirement that farmers be able to turn to the mechanic of their choosing to fix problems with their tractors' emissions systems. EPA should then take action to ensure that Deere comes into compliance.

Right to Repair laws would save U.S. farmers **\$4.2 BILLION PER YEAR**



Farmers have to go to the dealership for many tractor fixes, leading to inflated repair costs and downtime that can cause crop losses. Right to Repair, which would provide farmers with access to necessary repair materials, would save U.S. farmers \$4.2 billion a year.

Introduction

SCOTT BLUBAUGH, a fifth-generation farmer, works the land on their 5,000 acre plot in northern Oklahoma with his father. His son, who recently returned from college to eventually take over the family business, represents the sixth generation of Blubaughs to do so.¹²

The Blubaughs devote 2,000 acres of their land to cultivating wheat, soybeans, grain, sorghum wheat and hay. The remaining 3,000 acres are grass pasture land on which their beef cattle graze.¹³

Keeping up with a diversified operation such as theirs requires a lot of equipment. “We try to raise most of our own feed for our cattle operations. So, we have feed processing equipment, hay equipment, tractors and the combines to do the harvesting on the grain crops,” Scott told U.S. PIRG Education Fund.

The majority of this equipment is made by John Deere. “It’s not because we bleed green or anything,” Blubaugh said. “It is strictly the dealer network. It’s the only dealer network even close to my operation. And so, if I had more choices with the other manufacturers, then I would definitely be interested. But when you only have one, just John Deere is in your market, then you gotta have their equipment because you need their dealership to make the repairs.”

Farmers are reliant on manufacturer dealer networks because tractor-makers have engineered barriers to independent repair. Only authorized dealers can access software tools necessary to diagnose, calibrate and authorize many repairs.¹⁴ Without those tools, farmers and independent mechanics are unable to make those fixes, forcing farmers to turn to dealer mechanics instead.

Prior U.S. PIRG Education Fund research has demonstrated how modern farm equipment has been engineered to limit repair choices. Farmers and independent mechanics cannot access the software they need to comprehensively diagnose and troubleshoot tractors, nor can they install the embedded software necessary to electronically pair replacement parts to a machine—a process necessary to complete many repairs. As a result, they need to wait for a dealer to perform these functions; delays and equipment downtime ensue.¹⁵

Additionally, prior U.S. PIRG Education Fund research shows alarming consolidation amongst dealership networks, further reducing choice for farmers. As a result of this consolidation, there is only one John Deere dealership chain for every 12,018 U.S. farms and every 5.3 million acres of U.S. farmland.¹⁶

Too many breakdowns for “authorized” technicians to handle

DURING CRITICAL SEASONS, such as planting and harvest, when farmers are in the field, using their equipment nearly around the clock, their equipment breaks down regularly. “When harvest season starts in southeast Missouri, everybody’s running multiple combines, tractors, everything. That means more breakdowns,” said farmer and Missouri Rep. Barry Hovis in 2021.¹⁷

At the same time, dealerships are complaining of a shortage of equipment technicians to fix equipment in their ‘authorized’ settings. Many have pointed out this fact in hearings on Right to Repair at both the state and federal¹⁸ level.

“We do have an issue of uptime,” Eric Wareham, VP of government affairs for the North American Equipment Dealers Association told the Missouri House Committee on Agriculture. “At those critical junctures of harvest and planting, at those critical peak periods, we have a lack of capacity in our industry. And that means that we have a lack of technicians...we have just a lack of labor force.”¹⁹

Combining increased equipment breakdowns in high-use periods with a lack of technicians to fix that equipment leads to repair delays for many farmers.

That’s exactly what the Blubaughs faced when their tractor broke down in July. Scott told U.S. PIRG Education Fund that when the dealership finally made it out to use their tools—tools that farmers and

independent mechanics cannot access—to diagnose the tractor, the dealer told them that they would not be able to get the tractor into their shop and fix it for nine months. That would mean that Scott would be without that piece of equipment for the entire harvest and potentially some of the following planting season.²⁰

“At those critical junctures of harvest and planting, at those critical peak periods, we have a lack of capacity in our industry. And that means that we have a lack of technicians...we have just a lack of labor force.”

- Eric Wareham, North American Equipment Dealers Association

“Now this was a 20, 22 year old tractor. And so their priorities up there are gonna be to take care of the stuff that they just sold,” Scott said. “If you’re buying new stuff every year or two and you can do all that, then you’ve got preference to get in there.

“The guys like me—the smaller farmers—that have older equipment, we’re buying parts from them regularly. We’re trying to buy service from them. But we’re not gonna buy brand new equipment all the time. And so we’re at the back of the list [for repairs].”

Luckily for the Blubaughs, their dealer technician told them what the problem was. Many farmers who don’t experience such

dealer goodwill instead have to purchase expensive, non-comprehensive diagnostic tools. Deere's version of this software tool, Customer Service ADVISOR, requires a subscription than \$3,100 per year, plus an interface kit that costs \$1,376 for a total of \$4,476 in the first year. Despite the price tag, it does not include comprehensive diagnostic information, nor does it allow farmers to electronically pair parts to the tractor.

Because the dealer mechanic told the Blubaughs what the problem was, they were able to hire their independent mechanic to do the physical part of the job. Scott said that their independent mechanic bought the necessary parts from the dealership and installed them on the engine.²¹

To finalize the repair and get the tractor back in the field, however, the Blubaughs' independent technician needed to calibrate the new parts to certain specifications. Only the dealer had access to these specifications, Scott explained.

"These parts and other parts on the engine have to be timed and set just perfect in order to work," Scott explained. But the

dealer "would not give the specifications to [our mechanic]. They wouldn't give him the specifications. And they said, corporate won't allow us to do that. We can't give this to you. And we're like, well, you can't do the work. I mean, you know, you've told us nine months, we've got to have our tractor so we can plant our crops. But still the dealership said that they couldn't give that out."

That's where Scott's father hopped into action. Though not a large man—he stands about 5'3" and weighs roughly 150 pounds—Scott described him as having a large presence. "My father is a very strong-willed man of German ancestry. And he went up there and said, hey, look, you know, we bought this tractor. This is our information. Give us the specifications."

He had to "throw a fit" to get the dealership to finally call their corporate office. "After a while they decided it would be easier to give them to him than to keep putting up with him in their dealership and raising Cain," Scott said. About four weeks after their tractor broke down—or roughly four weeks of downtime—the independent mechanic was able to set the new parts and the Blubaughs' tractor was back in the field.

Repair restrictions cost farmers

FARMERS RELY ON their equipment to produce food at scale. During planting or harvest seasons, they can spend all day in the cabs of their tractors and harvesters. “When you use any piece of equipment that much, it’s going to break down. And when you have hundreds or thousands of acres that need planting, fertilizing or harvesting, you’re going to need to fix it,” said Jared Wilson, a farmer from Missouri.

That’s why repair has long been a reality of agricultural life. With some tractors costing as much as \$800,000,²² even the largest and most profitable farms cannot afford to buy a new combine every time one breaks down. They need to get their hands dirty and fix it or find a mechanic who can do it for them.

But farmers lack the repair choices they once had.²³

Manufacturers also readily admit that they prevent independent repairers from fixing problems related to emissions controls,²⁴ claiming that the Environmental Protection Agency (EPA) requires them to do so when the Clean Air Act appears to state the exact opposite.

As a result of limited tool access, dealership consolidation and the lack of dealer technicians, farmers report paying too much and waiting too long to get their equipment fixed. These trends show up in analysis of the total costs of repair and downtime.

Deere’s repair restrictions appear to violate the Clean Air Act

The Clean Air Act (CAA) requires that makers of nonroad engines, including those in tractors and combines, “state clearly in your written maintenance instructions that a repair shop or person of the owner’s choosing may maintain, replace, or repair emission-control devices and systems.”²⁵ Additionally, manufacturers must obtain a certificate to prove conformity with the CAA. The EPA can deny or revoke such a certificate if the information in the application is false or incomplete, or if the manufacturer takes any action that “otherwise circumvents the intent of the Act.”²⁶

Because farmers can’t fix problems with the emissions system themselves, farmers are left with a choice between dealing with the increased prices and delays that come with dealership repair, or turning to black-market options to get their equipment running. Tight planting and harvesting windows or weather that threatens their crop might motivate a farmer who would otherwise want to comply with the Clean Air Act to ‘chip’ their tractors—a process by which farmers can modify their tractor’s software to illegally bypass environmental controls.²⁷

Manufacturers including John Deere have vocally opposed Right to Repair efforts, which would restore the repair choice promised to farmers by the CAA. One Deere rep told the Nebraska senate that the company is, “required as a manufacturer to protect the emissions controls,” and that, “if we don’t comply with [EPA] requirements, they can, up to and including stop us from building engines.”²⁸ This statement appears to directly contradict the CAA.

For these reasons, Repair.org, U.S. PIRG and iFixit called on EPA to investigate John Deere’s repair restrictions and take necessary enforcement action.²⁹ The groups delivered 10,130 petition signatures to the EPA last December.

Dealer repair ain't cheap

REPAIR COSTS HAVE LONG been a significant portion of farmers' overall operating costs. But over the last 20 years repair costs per acre of the United States' most planted crops, corn and soybean, have increased at a concerning rate.

In 2021 farmers paid \$37.96 on repair costs per acre of corn planted, and \$31.43 per acre

of soybean. Those prices are nearly double inflation-adjusted 2001 rates: \$21.06 for corn and \$16.20 for soybean. These increases coincide with the trend of increasing amounts of software and software-linked parts in farm equipment—the mechanism through which manufacturers restrict independent repair.

FIGURE 1. USDA DATA: REPAIR COSTS INCREASE FOR CORN PRODUCERS

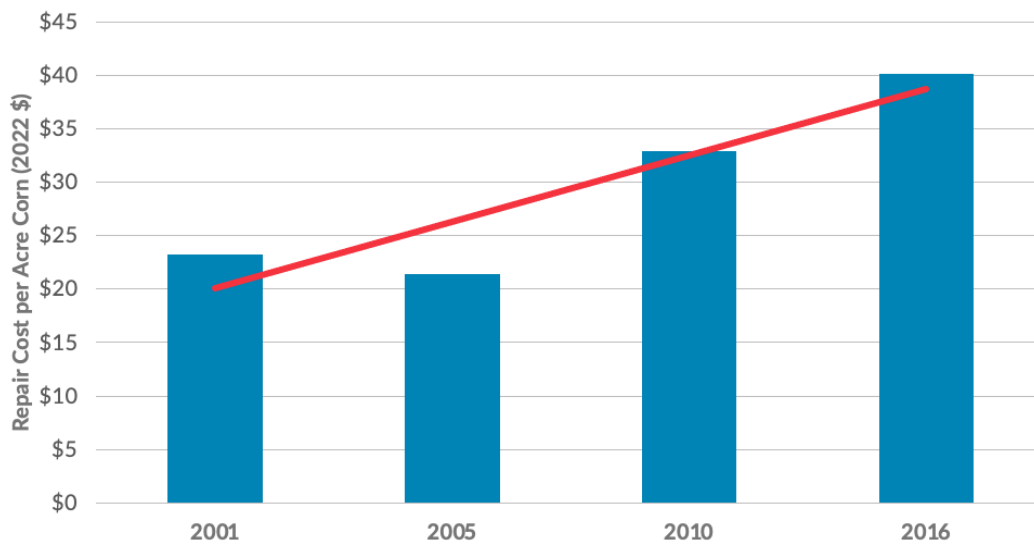
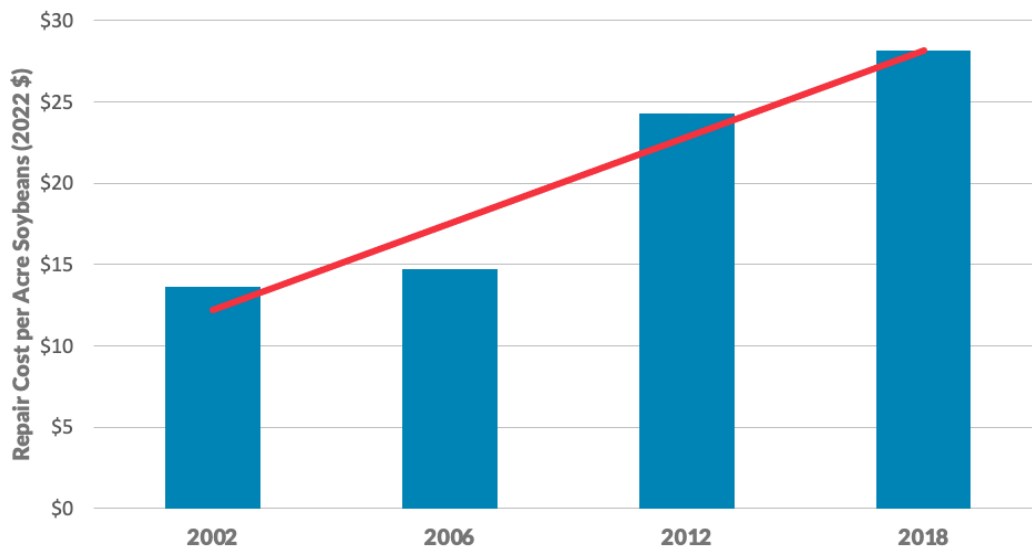


FIGURE 2. USDA DATA: REPAIR COSTS INCREASE FOR SOYBEAN PRODUCERS



Comparisons of labor rates is one factor in increased repair costs. For the 53 farmers across 14 states that took U.S. PIRG Education Fund and National Farmers Union's survey, dealer labor rates run considerably higher than those of independent mechanics. On average, unaffiliated mechanics charged \$89 per hour versus the dealer's \$148 per hour. That difference of \$59 per hour can add up to a significant sum over the course of the year.

"When I, or my independent mechanic, have the know-how and the time to fix my equipment myself, every extra dollar I have to pay the dealer mechanic comes directly out of my profits," Wilson, the Missouri-based farmer, said.

Some farmers have increasingly turned to older equipment to reduce reliance on their dealers,³⁰ avoiding high repair costs in the process. But this approach, while increasing independence, is not foolproof.

"Just keeping our equipment running has gotten more and more expensive over the past couple decades," said Walter Schweitzer, a fifth-generation farmer from Montana. "We were shelling out more for money to fix our equipment, particularly for the newer stuff. But even with our older machines—the stuff *without* software—we

were paying more because we were running up the hour counts. When stuff gets old, it breaks down more often."

Schweitzer's experience is borne out by the data—as equipment gets older, it becomes increasingly expensive to maintain. For example, an 180-horsepower diesel tractor that is used 400 hours per year for 15 years will have accumulated about 6,000 hours of use over that period. According to estimates from the American Society of Agricultural and Biological Engineers, the owner of this tractor will have spent about 25% of the new list price of the tractor on repair over those 6,000 hours of equipment use.³¹ That's \$50,000, assuming a \$200,000 list price.

Over the following 4,000 hours of use, however, the farmer will spend an additional \$90,000—or 45% of the new list price—on repairs. Other equipment, including combines and larger tractors, also get progressively more expensive to maintain as time goes on.³²

"The fact of the matter is we're damned if we do, damned if we don't," Schweitzer said, referring to the repair costs farmers have to pay whether they use newer equipment that they can't fix, or older equipment that they can. "We're getting it from all angles."

Downtime is dying time

IF A FARMER'S EQUIPMENT breaks down at the wrong time and they can't get it fixed, farmers can be forced to watch as their crop—and their profits—wither on the vine. Blubaugh, the Oklahoma farmer whose dealer quoted him a 9-month delay to repair his tractor, expressed concern that a similar prognosis for a combine could be disastrous. "You have a very short window to harvest that crop," he said. "The weather can damage the crop overnight and you can actually lose an entire crop in our part of the country overnight with hail and different things. And so being able to get that crop in in a timely manner is super important."

Of the 53 farmers who took the U.S. PIRG Education Fund and National Farmers Union survey, 53% reported losing crop or livestock due to a breakdown that led to downtime. Another 26% said they have almost lost crop or livestock in such situations.

Sarah Degn, a farmer from Eastern Montana, was dealing with downtime during harvest last October. "Right now, my combine is down and I've been waiting 3 days for a small spacer needed to put it back together," she told U.S. PIRG Education Fund and National Farmers Union. "Because it's a specialized part, I need it to be an original. It wasn't on hand since it is an older combine so I had to order through the dealer. In the meantime, the wind has blown 50 mph for the last 3 days and my soybean pods are cracking open in

places, dropping part of my crop on the ground while I wait."

Sometimes farmers are able to rely on backup equipment, which is often either smaller or older, to get the job done and avoid losing crop. Wyatt Parks of Minnesota had this happen recently with his tractor that he says frequently has problems with the emissions system, leading it to 'derate,' or reduce power to a point where he can't get any work done until a manufacturer technician fixes the problem.

"Most recently it acted up as I was mowing down old crop residue to get ready for some late fall plantings—cover crops and garlic," Parks said. "Thankfully we had a smaller machine on hand that was able to wrap up the work before it rained. But if we had lost a few days due to downtime we could have missed the window to prep the field."

Changing weather patterns caused by climate change are not helping, Parks says. "Weather windows seem to be getting shorter each year. On Tuesday it was near 80 and sunny and today (Friday) it is freezing and snowing."

This can be as big of a problem for ranchers as it is for crop farmers. Becky Potmesil, who runs a cow/calf operation with her husband, Scott, said that their "tractor shut down just because of a sensor right before a big snow storm while trying to get cattle bedded down along windbreaks." Potmesil reports that has happened more than once.

Not all farmers, however, are lucky enough to make it out without losing yield. Delaying harvest by just a few days can reduce the overall yield by as much as half of the expected crop.³³

South Dakota farmer Jeff Kippley dealt with a broken sensor on his planter on a Friday during planting season. He did not have the necessary software tools, meaning he could

not identify which sensor was having the problem. The manufacturer technician could not make it to his farm until Monday afternoon, he said, meaning he could not plant over the weekend. Rain started Tuesday morning—Kippley says his crop was put back over a week and a half, resulting in a 20% yield loss.

Tractor downtime from repair restrictions costs U.S. farmers **\$3 BILLION PER YEAR**



Manufacturer-imposed repair restrictions can turn a tractor breakdown into **weeks or months of equipment downtime**, which can lead to crop losses as tight planting and harvesting windows close or harsh weather threatens. That downtime costs U.S. farmers \$3 billion a year.

Ill-timed breakdowns can cost the farm

LOSING CROP MEANS losing profits. At a certain point, if farmers lose too much profit, they can lose the farm all together.

While farmers report trying to avoid this outcome through crop insurance, keeping backup equipment and other risk-mitigation measures, some still fear that the unimaginable could

happen—roughly one in three farmers surveyed fear losing the farm. Stuart Beam, a farmer in North Carolina, explained the concern at an informational hearing on Right to Repair in his home state last October. To address manufacturers and dealers' common claim that farmers can fix 98% of problems with their tractors, he said, "You don't need a dealer to tell you your tire's flat. You don't need a dealer to tell

your fuel's leaking. But the 2% of repairs that farmers can't make are the ones that bankrupt farms."

Sarah Degn of Montana credits crop insurance as a reason that she would be unlikely to lose her farm. "But if it's a year where you needed a piece of equipment or added more land, you can find yourself over extended fast if you can't get your crop to market in a timely manner," she said. Beau Locken, a North Dakota farmer who once lost an entire soybean crop when both of his combines broke down right before getting two feet of snow, said he is "terrified and anxious. All of the time," about losing the farm.

Repair restrictions leading to bankruptcy are one of many fears that are leading to increasing rates of anxiety, depression and mental health problems for farmers. Many are turning to resources like the Nebraska Rural Response Hotline (NRRH), which provides a wide range of services to farm

and ranch families in crisis including food assistance, bookkeeping, financial, and legal assistance.

"Based on the use of the hotline's financial and emotional stress services, farm stress is very high," said Nebraska Farmers Union President John Hansen, whose organization is one of the founding sponsors of the program. "This past year, 80 percent of Nebraska has been in some sort of severe drought. Lots of cow/calf folks were not able to grow the pasture and hay they need. Not being able to fix your own equipment is one additional financial squeeze farmers just don't need."

Hansen said the Hotline provides mental health vouchers that enable farmers to seek professional mental health counseling from the statewide network of ag knowledgeable providers. He said during the past two years nearly four times as many vouchers were utilized as in 2019.

Increased labor costs from repair restrictions cost U.S. farmers

\$1.2 BILLION PER YEAR



Right to Repair would save farmers money

REPAIR RESTRICTIONS COST FARMERS

through the need to pay dealers' higher labor rates, and added downtime waiting for dealers that can cost them some, or all, of their crop. Right to Repair reforms would provide farmers with relief from these unnecessary costs.

Model Right to Repair legislation would require equipment manufacturers to provide farmers and independent mechanics, as well as mechanics working for competing manufacturers, with all parts, tools, software tools and information necessary to fix modern equipment on fair and reasonable terms.³⁴ That would mean that equipment owners and third-party fixers would be able to acquire and use *all* the tools needed to diagnose *all* the

problems with tractors and combines, just as they would be able to pair parts to a machine as necessary to finalize and authorize a repair.

U.S. PIRG Education Fund and National Farmers Union's survey of 53 farmers across 14 states found that providing farmers and independent mechanics with comprehensive repair access would save these farmers an average of \$1,328 in labor costs and \$3,348 in avoided downtime each year.

If all U.S. farmers enjoy savings similar to the farmers that took our survey, Right to Repair would save farmers a total of \$4.2 billion—\$1.2 billion in labor costs and \$3 billion in avoided downtime.

Right to Repair laws would save U.S. farmers **\$4.2 BILLION PER YEAR**



Farmers have to go to the dealership for many tractor fixes, leading to inflated repair costs and downtime that can cause crop losses. Right to Repair, which would provide farmers with access to necessary repair materials, would save U.S. farmers \$4.2 billion a year.

Recommendations

To protect farmers from unnecessarily high repair costs and our food system from unnecessary loss of crop, policymakers should take the following actions.

State and federal lawmakers should pass Right to Repair legislation. Ensuring that all necessary repair parts, tools, information and software necessary to repair are available at a fair and reasonable price will provide farmers with the ability to fully diagnose and repair their equipment, while creating the environment necessary for a thriving independent repair ecosystem.

Congress should reform Section 1201 of the Digital Millennium Copyright Act to state that repair is not a crime. Section 1201 was designed to protect copyrighted works from piracy, but has been abused by manufacturers to restrict repair access. By passing legislation such as the bipartisan Freedom to Repair Act, Congress would offer a narrow, permanent exemption for diagnosis, maintenance, and repair from

Section 1201—a fix the U.S. Copyright Office has called for since 2017. This would allow the creation of third-party diagnostic and repair tools, introducing more competition and further bringing down costs and service delays.

The Environmental Protection Agency should investigate John Deere’s potentially illegal repair restrictions. The Clean Air Act requires that makers of engines, including those in tractors and combines, allow farmers to select the repair shop or person of their choosing to maintain, replace or repair emission-control devices and systems.³⁵ But farmers cannot access the software tools to diagnose and authorize these repairs,³⁶ meaning they are left with two bad options: risk losing their crop while waiting days to weeks for a dealer fix, or upload illegal software that allows them to bypass emissions controls so that they can get back to work. The EPA should investigate these practices, and correct the record where Deere representatives have incorrectly stated that emissions regulations require repair restrictions.

Methodology

This report estimates the total cost of downtime and additional labor costs based on a model created using survey and USDA data.

U.S. PIRG Education Fund and National Farmers Union surveyed 53 tractor-using farmers from 14 states between October and December 2022 on the breakdowns and repairs they had experienced in the year prior. Participation was voluntary, and all data was self-reported by respondents. The survey collected additional information about the respondents beyond what is covered in this report.

The survey data was used to calculate average numbers of repairs per tractor, rates of repair type (self, independent mechanic, dealer), average hourly labor costs, average hours per repair by type, the average cost of an hour of tractor downtime, and the average percentage of dealer repairs that farmers or their independent mechanics could fix if they had access to the necessary repair materials. The cost of farmer labor was determined by consulting USDA Research Agricultural Economist David Williams.

We excluded survey responses that listed the cost of tractor downtime of less than \$100 and greater than \$1500 to ensure a more accurate, but conservative estimate. Responses that led to labor hours of more than 100 hours per repair were also left out of our calculations.

Data on the number of tractors and the number of farms with tractors in the U.S. and each state from the most recent USDA Census of Agriculture, conducted in 2017,³⁷ was used to calculate the average number of tractors per farm both nationally and on a state-by-state basis.

To determine how much Right to Repair would save the farmers in our sample, we used the percentage of repairs that farmers or independent mechanics could have fixed with access to repair materials, as well as the reported proportions of self and independent repair for non-dealer repairs, to project how many dealer repairs would shift to the other types of repair. We assumed that farmers would do as many repairs as possible themselves (i.e., do all non-dealer repairs they are capable of themselves at the same rate as our sample reported doing) and would use an independent mechanic for all other repairs that either the farmer or independent mechanic could do, but would still have to turn to the dealer for some repairs. Those calculations allowed us to estimate how the number of repairs of each type would change and, therefore, the difference in downtime costs and labor rates.

We extrapolated the downtime and labor savings from our sample to provide nation-wide savings by first calculating the labor and downtime savings per tractor for our sample. We then used USDA Census of Agriculture data on the count of tractors in each state and in the U.S. to calculate the total savings per state and nationally.

Appendix: Right to Repair savings by state

State	Total Savings	Downtime	Labor
Alabama	\$75,665,986	\$54,178,004	\$21,487,982
Alaska	\$1,238,173	\$886,551	\$351,622
Arizona	\$14,376,964	\$10,294,126	\$4,082,838
Arkansas	\$81,459,050	\$58,325,927	\$23,133,124
California	\$144,296,569	\$103,318,551	\$40,978,018
Colorado	\$61,267,153	\$43,868,219	\$17,398,934
Connecticut	\$10,799,906	\$7,732,898	\$3,067,008
Delaware	\$5,765,989	\$4,128,537	\$1,637,453
Florida	\$64,367,271	\$46,087,951	\$18,279,320
Georgia	\$81,315,343	\$58,223,030	\$23,092,313
Hawaii	\$5,201,574	\$3,724,407	\$1,477,168
Idaho	\$47,986,737	\$34,359,238	\$13,627,499
Illinois	\$189,199,850	\$135,469,987	\$53,729,862
Indiana	\$126,160,308	\$90,332,711	\$35,827,597
Iowa	\$230,861,389	\$165,300,287	\$65,561,102
Kansas	\$114,809,525	\$82,205,377	\$32,604,148
Kentucky	\$154,565,383	\$110,671,179	\$43,894,204
Louisiana	\$52,598,904	\$37,661,620	\$14,937,284
Maine	\$13,953,132	\$9,990,656	\$3,962,476
Maryland	\$29,470,382	\$21,101,244	\$8,369,137
Massachusetts	\$13,276,251	\$9,505,999	\$3,770,252
Michigan	\$123,979,708	\$88,771,368	\$35,208,340
Minnesota	\$206,795,646	\$148,068,847	\$58,726,799
Mississippi	\$64,579,707	\$46,240,059	\$18,339,649
Missouri	\$183,869,147	\$131,653,123	\$52,216,024
Montana	\$51,162,873	\$36,633,400	\$14,529,473
Nebraska	\$124,898,185	\$89,429,011	\$35,469,173
Nevada	\$6,549,089	\$4,689,248	\$1,859,841
New Hampshire	\$6,968,756	\$4,989,736	\$1,979,020

State	Total Savings	Downtime	Labor
New Jersey	\$22,002,816	\$15,754,353	\$6,248,463
New Mexico	\$24,408,349	\$17,476,751	\$6,931,598
New York	\$98,232,175	\$70,335,741	\$27,896,435
North Carolina	\$102,808,936	\$73,612,771	\$29,196,165
North Dakota	\$78,952,506	\$56,531,202	\$22,421,304
Ohio	\$183,626,511	\$131,479,392	\$52,147,119
Oklahoma	\$121,909,492	\$87,289,062	\$34,620,430
Oregon	\$63,359,238	\$45,366,184	\$17,993,054
Pennsylvania	\$140,711,179	\$100,751,357	\$39,959,822
Rhode Island	\$1,975,453	\$1,414,454	\$560,998
South Carolina	\$47,850,319	\$34,261,561	\$13,588,758
South Dakota	\$85,457,858	\$61,189,134	\$24,268,724
Tennessee	\$131,260,871	\$93,984,792	\$37,276,079
Texas	\$362,479,445	\$259,540,829	\$102,938,616
Utah	\$27,131,495	\$19,426,566	\$7,704,930
Vermont	\$14,469,645	\$10,360,487	\$4,109,158
Virginia	\$91,005,163	\$65,161,089	\$25,844,074
Washington	\$65,940,760	\$47,214,593	\$18,726,167
West Virginia	\$43,086,114	\$30,850,317	\$12,235,797
Wisconsin	\$190,163,104	\$136,159,692	\$54,003,412
Wyoming	\$20,829,208	\$14,914,031	\$5,915,176
United States	\$4,205,099,590	\$3,010,915,651	\$1,194,183,939

Endnotes

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