



## The Unbridled Potential of the Future Farm Economy

By Nan Swift

**Reforming and reducing federal agriculture subsidies would help reverse some of the challenges perpetuated by current policy.**

### Executive Summary

For the last 20 years, median farm households have reliably out-earned other households in the United States. A century ago, this kind of consistent abundance would have been a thing of dreams for hardscrabble farmers on the precipice of the Dust Bowl and economic disaster.

To get here, though, a significant toll was imposed: an overly generous farm safety net. This safety net has subsidized farmers' success, but it has done so at the expense of our national debt, environment and innovation.

The first paper in this two-part series, "The Shaky Foundations of Modern Farm Policy," demonstrated that modern farm policies are outdated and ineffective, having been developed to address historic farming challenges that differed markedly from the challenges farmers face today.<sup>1</sup> This second paper asserts that the current farm economy has the stability to support reform and explains how current farm policies are hindering the innovation needed to better support

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1. Nan Swift, "The Shaky Foundations of Modern Farm Policy," *R Street Policy Study* No. 284, May 2023. <https://www.rstreet.org/wp-content/uploads/2023/05/Final-Study-No.-284.pdf>.

tomorrow's farm economy. It also includes two case narratives to highlight examples of innovative farm technologies that might be more widely adopted if federal subsidies were reformed to encourage agribusinesses to take on more of their own risk and seek new ways to be competitive.

## Introduction

The U.S. farm economy has faced many challenges in recent years. A costly trade war with China resulted in retaliatory actions against soybeans.<sup>2</sup> Tariffs on steel and aluminum imports increased the cost of agriculture equipment.<sup>3</sup> A historic derecho ripped across the heartland right before harvest time.<sup>4</sup> This past summer, key growing regions experienced far too much or far too little water.<sup>5</sup>

Despite these challenges, agriculture is a resilient economic sector, and many farm households and businesses continue to thrive.<sup>6</sup> This stability suggests that it is time to consider addressing overly generous federal agriculture subsidies, which were built for a bygone era and have become problematic for today's farm economy in many ways.<sup>7</sup> Most obviously, the subsidies contribute to record-high levels of national debt: Estimates predict that more than \$12.6 billion in farm subsidies will be paid out in 2023 alone.<sup>8</sup> Subsidy structures also underpin a host of environmental problems, such as the plowing under of lands and habitats with little agricultural value, the depletion of aquifers, and the creation of dead zones resulting from soil-enriching nitrogen and phosphorus runoff.<sup>9</sup>

Equally troubling, these subsidies impede the adoption of new farm technologies that could advance U.S. agriculture in groundbreaking ways. Innovative solutions—like indoor farms that mitigate weather issues, robot milkers that reduce the labor burden and AI-driven precision farming that can reduce the need for potentially harmful pesticides—are all ripe for integration.<sup>10</sup> Unfortunately, farm subsidies weaken the incentive to adopt these technologies and place an unfair burden on those farmers who take the risk to do so, as the current structure offers more support to traditional farms and crops.<sup>11</sup>



Estimates predict that more than  
**\$12.6 BILLION**  
in farm subsidies will be paid out  
in 2023 alone.

2. Amanda Snell, "American Farmers Are the Casualties of Trump's Trade War," Foundation for Economic Education, June 5, 2019. <https://fee.org/articles/american-farmers-are-the-casualties-of-trump-s-trade-war>.
3. "Ag Equipment Manufacturers Seeing Impacts of Steel Tariffs," Farm Equipment, July 1, 2018. <https://www.farm-equipment.com/articles/15774-ag-equipment-manufacturers-seeing-impacts-of-steel-tariffs>.
4. Virginia Barreda, "Today marks 2 years since devastating Aug. 10 derecho slammed Iowa," *Des Moines Register*, Aug. 10, 2022. <https://www.desmoinesregister.com/story/weather/2022/08/10/iowa-weather-two-years-since-derecho-blew-across-state/10286537002>.
5. National Centers for Environmental Information, "August 23 Drought Report," National Oceanic and Atmospheric Administration, Sept. 14, 2023. <https://www.ncei.noaa.gov/access/monitoring/monthly-report/drought/202308>.
6. Economic Research Service, "Real Farm Income," U.S. Department of Agriculture, August 2023, p. 7. <https://www.govinfo.gov/content/pkg/ECONI-2023-08/pdf/ECONI-2023-08-Pg7.pdf>.
7. Swift. <https://www.rstreet.org/wp-content/uploads/2023/05/Final-Study-No.-284.pdf>.
8. Ibid.; Economic Research Service, "Federal Government direct farm program payments, 2014-2023F," U.S. Department of Agriculture, Aug. 31, 2023. <https://data.ers.usda.gov/reports.aspx?ID=17833>.
9. Caroline Melear, "Environmental Benefits of Crop Insurance Reform," *R Street Shorts* No. 130, October 2023. <https://www.rstreet.org/research/environmental-benefits-of-crop-insurance-reform>.
10. See, e.g., "About Us," Bowery, last accessed Oct. 17, 2023. <https://bowery.co/about-us>; "Lely Astronaut A5," Lely, last accessed Oct. 16, 2023. <https://www.ley.com/us/solutions/milking/astonaut-a5>.
11. Swift. <https://www.rstreet.org/wp-content/uploads/2023/05/Final-Study-No.-284.pdf>.

In this paper, we recommend that Congress consider modest, targeted reforms to better support innovation and unleash the potential of our farm economy. We show that, because the farm economy is flourishing, there is ample financial breathing room to reform taxpayer-funded subsidies.<sup>12</sup> We also explain how federal subsidies reward business as usual and use the example of New Zealand to show how major farm-policy changes can strengthen a country's agriculture industry. We then briefly explore some of the once-unimaginable innovations that, absent the constraints inherent in the current subsidy structure, could help propel future economic success while reducing some of the risks and costs of farming—and lowering the taxpayer tab.

As an additional special feature, this paper also includes two narratives of agribusinesses that have embraced an innovative approach to farming. These narratives are intended to provide a firsthand account for readers who may be unfamiliar with changing farm technologies. At Bowery Farming, their indoor farm model avoids many of the pitfalls of conventional farming and provides an improved end-product for consumers. At a Pennsylvania dairy, a robot creates efficiencies for the farm owner and improves health outcomes for the cows.

## The State of the U.S. Farm Economy

During the previous farm bill debate in 2018, members of Congress made dire statements about struggling farmers coping with the weight of a “five-year recession,” which aligned with the typical gloom-and-doom narrative perpetuated by an industry that faces many risks.<sup>13</sup> But that sentiment against revising federal agriculture policy lacked critical context. Although it was true that, in 2018, net farm income was down from a high of \$159.9 billion in 2013, it is important to recognize that 2013 was an anomaly—a then record-high because of robust yields and a massive spike in corn prices in 2012—and not the new norm.<sup>14</sup> By 2018, farm income was trending steadily upwards (Figure 1).<sup>15</sup>

Today, the numbers confirm that the U.S. farm sector is strong. Although income variation exists within the industry, taken as a whole, the past five years have seen notable growth, with 2022 income levels being three times higher than the income levels of the early 2000s (Figure 1).<sup>16</sup> Likewise, median farm household income continues to outperform median U.S. household income (Figure 2), as it

## FARM TECH NARRATIVES

**Bowery Farming:  
An Indoor Smart Farm**  
[Read Narrative](#)

**EsBern-OM Holsteins:  
Robot Milkers**  
[Read Narrative](#)

### Figure 1 Key Takeaways

12. Economic Research Service, “Farm Household Income Preliminary Estimate for 2022 and Forecast for 2023—August 2023 Update,” U.S. Department of Agriculture, Aug. 31, 2023. <https://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/farm-household-income-forecast>; “Income in the United States: 2022,” United States Census Bureau, Sept. 12, 2023. <https://www.census.gov/library/publications/2023/demo/p60-279.html>.

13. Erica Werner and Mike DeBonis, “In blow to GOP, House fails to pass massive farm bill in face of conservative Republican showdown,” *The Washington Post*, May 18, 2018. <https://www.washingtonpost.com/news/business/wp/2018/05/18/house-moves-toward-vote-on-farm-bill-with-outcome-uncertain-in-dispute-over-immigration/>; Economic Research Service, “Risk in Agriculture,” U.S. Department of Agriculture, May 3, 2023. <https://www.ers.usda.gov/topics/farm-practices-management/risk-management/risk-in-agriculture>.

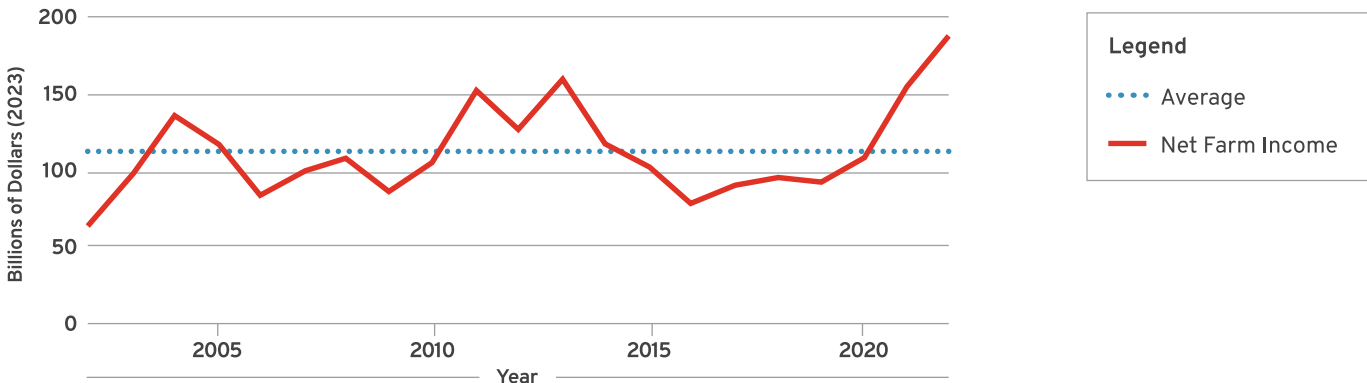
14. Economic Research Service, “Real Farm Income,” U.S. Department of Agriculture, Aug. 2023, p. 7. <https://www.govinfo.gov/content/pkg/ECONI-2023-08/pdf/ECONI-2023-08-Pg7.pdf>; Randy Schnepf, “U.S. Farm Income,” Congressional Research Service, Aug. 30, 2013. [https://www.everycrsreport.com/files/20130830\\_R40152\\_1d9be6266c698567d7d9a6a47fa8ddd1df689302.pdf](https://www.everycrsreport.com/files/20130830_R40152_1d9be6266c698567d7d9a6a47fa8ddd1df689302.pdf).

15. Ibid.

16. Ibid.

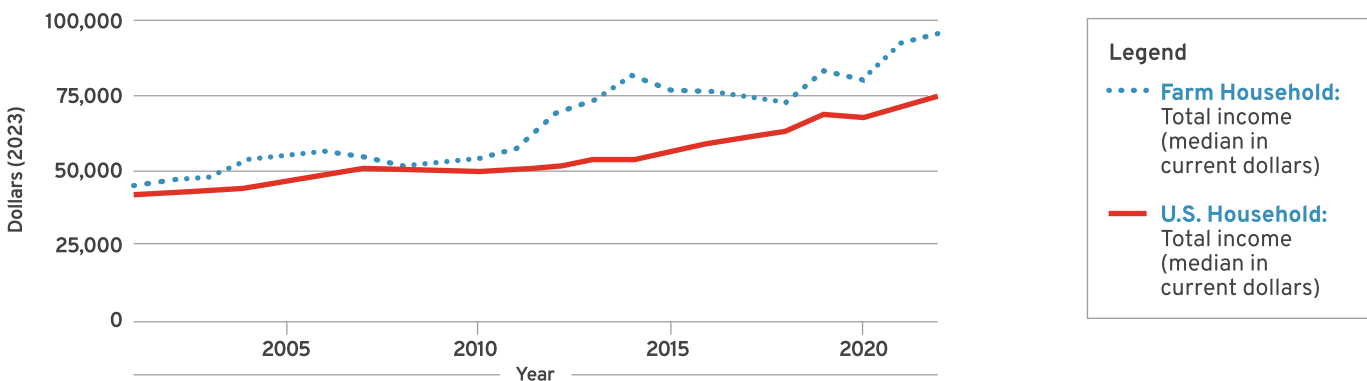
has for the last two decades.<sup>17</sup> Furthermore, even though the U.S. Department of Agriculture predicts that net farm income will decrease to \$141.3 billion in 2023, income will still be notably higher than both the 20-year average and net income levels for 2020.<sup>18</sup>

**Figure 1: Net Farm Income (2002–2022)**



Source: Economic Research Service, “Real Farm Income,” U.S. Department of Agriculture, August 2023, p. 7. <https://www.govinfo.gov/content/pkg/ECONI-2023-08/pdf/ECONI-2023-08-Pg7.pdf>.

**Figure 2: Median Household Income: Farm vs. U.S.**



Sources: Economic Research Service, “Farm Household Income Preliminary Estimate for 2022 and Forecast for 2023—August 2023 Update,” U.S. Department of Agriculture, Aug. 31, 2023. <https://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/farm-household-income-forecast>; “Income in the United States: 2022,” United States Census Bureau, Sept. 12, 2023. <https://www.census.gov/library/publications/2023/demo/p60-279.html>.

The agriculture sector also currently has one of the lowest bankruptcy rates among all industries, comprising only 4 percent of business cases between 2014 and 2021.<sup>19</sup> In addition, farm business balance sheets are healthy, enjoying an extremely low debt-to-asset ratio of only 12.93 percent—a value that is expected to continue to drop.<sup>20</sup>

17. Economic Research Service, “Farm Household Income Preliminary Estimate for 2022 and Forecast for 2023—August 2023 Update,” U.S. Department of Agriculture, Aug. 31, 2023. <https://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/farm-household-income-forecast>; “Income in the United States: 2022,” United States Census Bureau, Sept. 12, 2023. <https://www.census.gov/library/publications/2023/demo/p60-279.html>.

18. Economic Research Service, “2023 Farm Sector Income Forecast,” U.S. Department of Agriculture, Aug. 31, 2023. <https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/farm-sector-income-forecast>.

19. “Share of business bankruptcy cases filed in the United States between 2014 and 2021, by industry,” Statista, Sept. 20, 2023. <https://www.statista.com/statistics/1116955/share-business-bankruptcies-industry-united-states>.

20. Economic Research Service, “Farm Sector Balance Sheet, 2014–2023F,” U.S. Department of Agriculture, Aug. 31, 2023. <https://data.ers.usda.gov/reports.aspx?ID=17835>; Economic Research Service, “Farm Sector Income & Finances: Assets, Debt, and Wealth,” U.S. Department of Agriculture, Aug. 31, 2023. <https://www.ers.usda.gov/topics/farm-economy/farm-sector-income-finances/assets-debt-and-wealth>.

## Subsidizing the Status Quo

Given the robust state of the farm economy, it is time to reexamine the generous subsidy regime that taxpayers underwrite for these businesses. The U.S. Department of Agriculture oversees a variety of subsidy programs for U.S. farmers (see box below), including commodity-support programs (like agriculture risk coverage [ARC] and price loss coverage [PLC]), crop insurance and disaster aid. Unfortunately, these programs are not well positioned to support farming innovations. Instead, they are set up to reward business as usual, relying on dated concepts of central planning and the distribution of billions of dollars each year with no long-term benefits.<sup>21</sup>



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## Major Federal Agriculture Subsidies

**Commodity-Support Programs:** ARC and PLC programs essentially guarantee income for certain growers by setting a minimum price floor for designated crops.<sup>22</sup>



**Crop Insurance:** Farmers pay only 38 percent of crop insurance premiums (taxpayers cover the rest), and private insurers are guaranteed to receive a 14.5 percent rate of return, along with reimbursement for administrative costs.<sup>23</sup>



**Disaster Aid:** Often provided on an ad hoc basis, disaster aid is typically dispensed whether or not farmers have taken other reasonable risk-reduction measures (such as purchasing crop insurance) and pays out for losses that should already be covered by the two aforementioned subsidies.<sup>24</sup>



Commodity programs provide a safety net for select crops, incentivizing farmers and the financial institutions that back them to stick to the prescribed, Congress-backed choices, regardless of growing conditions or market demands. This can motivate farmers to plant on lands with questionable agricultural value and ignore best practices such as crop rotation or planting cover crops. In turn, this can lead to soil degradation and the overuse of costly fertilizers, both of which can have harmful downstream effects.<sup>25</sup> Indeed, experts have found that taxpayer-funded crop insurance can encourage farmers to take environmentally unsound risks and avoid taking steps to adapt to climate change.<sup>26</sup>

21. Swift. <https://www.rstreet.org/wp-content/uploads/2023/05/Final-Study-No.-284.pdf>; “CBO’s May 2023 Baseline for Farm Programs,” Congressional Budget Office, May 2023. [https://www.cbo.gov/system/files/2023-05/51317-2023-05-usda\\_0.pdf](https://www.cbo.gov/system/files/2023-05/51317-2023-05-usda_0.pdf).

22. Farm Service Agency, “ARC/PLC Program,” U.S. Department of Agriculture, last accessed Oct. 1, 2023. [https://www.fsa.usda.gov/programs-and-services/arcplc\\_program/index](https://www.fsa.usda.gov/programs-and-services/arcplc_program/index).

23. Caroline Melear and Jerry Theodorou, “Crop Insurance Reform,” *R Street Policy Study* No. 280, March 2023. <https://www.rstreet.org/wp-content/uploads/2023/03/r-street-policy-study-no-280-R3-1.pdf>; “Farm Bill Folly,” Taxpayers for Common Sense, May 19, 2023. <https://www.taxpayer.net/agriculture/farm-bill-folly>.

24. Farm Service Agency, “Disaster Assistance Programs,” U.S. Department of Agriculture, last accessed Oct. 1, 2023. <https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index>.

25. “Environmentally Harmful Subsidies: Policy Issues and Challenges,” Organisation for Economic Co-Operation and Development, 2003. <https://www.cbd.int/financial/fiscalenviron/g-subsidyharmful-oecd.pdf>.

26. Anne Schechinger, “Federal Crop Insurance Program reforms can help farmers adapt to climate crisis and cut taxpayer costs,” Environmental Working Group, Aug. 3, 2023. <https://www.ewg.org/news-insights/news/2023/08/federal-crop-insurance-program-reforms-can-help-farmers-adapt-climate>.

Federal subsidies also tend to flow to the largest, wealthiest producers who need help the least.<sup>27</sup> In fact, one group looked at ARC payments and found that from 1995 to 2021, the top 10 percent of ARC recipients received 62 percent of payments.<sup>28</sup> And those wealthier producers have been able to maintain their “top-dog” status through consolidation and the creation of ever-larger agribusinesses.<sup>29</sup> This has driven up land prices, making it difficult for young farmers to access the land needed to start their own businesses.<sup>30</sup> Thus, these subsidies actively distort markets, harm the environment, exacerbate inequality and saddle taxpayers with additional debt.<sup>31</sup>

At the root of these problems lies a fundamental economic principle: subsidies impede innovation.<sup>32</sup> If subsidies are providing a payout regardless of circumstance, there is little incentive to make substantive changes or adjust practices to remain competitive. That does not mean that farmers are using outdated practices, but it does mean that they likely are not innovating as quickly or as significantly as they might in the absence of overly generous safety nets. It also means that innovative farmers who are growing specialty crops or implementing novel practices like vertical farming or regenerative farming techniques are at a significant disadvantage.<sup>33</sup>

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## New Zealand: The Benefits of Fewer Subsidies

Reforming and reducing federal agriculture subsidies would help reverse some of the challenges perpetuated by current policy. Consider an example set by New Zealand, which phased out their substantive agriculture subsidy program between 1984 and 1987 in response to a fiscal crisis that required spending cuts.<sup>34</sup> After an adjustment period, the agriculture sector not only recovered back to baseline levels—it expanded.<sup>35</sup> In addition, many of New Zealand’s farming-related environmental issues that resulted from poorly targeted agriculture subsidies (e.g., pollution, lack of biodiversity, soil erosion) were improved or eliminated.<sup>36</sup>



27. Economic Research Service, “The Evolving Distribution of Payments From Commodity, Conservation, and Federal Crop Insurance Programs,” U.S. Department of Agriculture, November 2017. [https://www.ers.usda.gov/webdocs/publications/85834/eib184\\_summary.pdf](https://www.ers.usda.gov/webdocs/publications/85834/eib184_summary.pdf).

28. “Agricultural Risk Coverage (ARC) Program payments in the United States totaled \$17.5 billion from 1995–2021,” Environmental Working Group, last accessed Oct. 1, 2023. [https://farm.ewg.org/progdetail.php?fips=00000&progcode=total\\_arc&page=conc&regionname=theUnitedStates](https://farm.ewg.org/progdetail.php?fips=00000&progcode=total_arc&page=conc&regionname=theUnitedStates).

29. Taylor Kaus et al., “Farm Consolidation and Crop Insurance Premium Subsidies,” Center for Agricultural Profitability, Jan. 14, 2022. <https://cap.unl.edu/crops/farm-consolidation-and-crop-insurance-premium-subsidies>.

30. Pavel Ciaian et al., “The Capitalization of Agricultural Subsidies into Land Prices,” *Annual Review of Resource Economics* 13 (October 2021), pp. 17–38. <https://www.annualreviews.org/doi/full/10.1146/annurev-resource-102020-100625>; Rachel Wagoner, “New farmers struggle with land access,” *Farm and Dairy*, May 27, 2021. <https://www.farmanddairy.com/news/new-farmers-struggle-with-land-access/665547.html>.

31. “CBO’s May 2023 Baseline for Farm Programs.” [https://www.cbo.gov/system/files/2023-05/51317-2023-05-usda\\_0.pdf](https://www.cbo.gov/system/files/2023-05/51317-2023-05-usda_0.pdf).

32. Veronique de Rugy, “Subsidies Are the Problem, Not the Solution, for Innovation in Energy,” Mercatus Center, March 24, 2015. <https://www.mercatus.org/research/federal-testimonies/subsidies-are-problem-not-solution-innovation-energy>.

33. Grey Moran, “How Crop Insurance Prevents Some Farmers From Adapting to Climate Change,” Civil Eats, Sept. 20, 2023. <https://civileats.com/2023/09/20/how-crop-insurance-prevents-some-farmers-from-adapting-to-climate-change>.

34. “New Zealand: Removal of agricultural and fisheries subsidies,” Convention on Biological Diversity, last accessed Oct. 1, 2023. <https://www.cbd.int/doc/case-studies/inc/cs-inc-newzealand-technical-en.pdf>.

35. Ibid.

36. Ibid.

## New Technologies in Action

If subsidies were to be scaled down and retooled and if farmers were driven to adopt new practices to be profitable and competitive, countless innovative solutions could be applied to meet the unique needs of any given farm. Currently available innovations are exciting and impressive and include advances such as fully autonomous tractors, precision agriculture, AI-enhanced systems, drones and even microbe-based fertilizer systems.<sup>37</sup>

These technologies have the capacity to help address some of the most persistent problems exacerbated by federal subsidies. For example, smarter, precision farming can help reduce water and fertilizer use, saving valuable resources and avoiding unnecessary run-off. Machines can work around the clock to bring in a harvest ahead of a harmful weather event with less labor. Better information about weather, soil and other conditions can help maximize yields without the need to plow under sensitive areas better left to protect waterways or wildlife habitats.

Of course, high-tech solutions often require a significant investment. But that investment makes sense when agribusinesses shoulder more of their own risk and are driven to compete in a healthier marketplace. If government were to stop playing favorites with crops or techniques, more producers might find that it pays to experiment.

Two case narratives are included at the end of this paper to highlight innovative farm technologies that might be more widely adopted if federal subsidies were reformed to encourage agribusinesses to take on more of their own risk and seek new ways to be competitive.

## Conclusion

Federal agriculture subsidies are not merely serving to support the status quo of large farms: They are holding back the enormous economic potential and environmental benefits that could be generated from a more competitive, more innovative U.S. farm industry.

It is time for members of Congress to have an open debate about what farmers truly need and what taxpayers can afford. Doing so would present an exciting opportunity to prioritize reforms that decrease market distortions, treat people and farming methods equitably, devalue environmentally harmful farming practices, and reduce the reward of repetitive losses.

By implementing market-based reforms designed to reduce and reinvent the farm safety net, policymakers could spark a technological revolution that would bring about long-term economic prosperity for American farmers, better products for consumers and lower taxpayer investments.



If subsidies were to be scaled down and retooled and if farmers were driven to adopt new practices to be profitable and competitive, countless innovative solutions could be applied to meet the unique needs of any given farm.

37. "Autonomous Farm Tractors: The Future of Farming," Bear Flag Robotics, last accessed Oct. 1, 2023. <https://www.bearflagrobotics.com/autonomous-farm-tractors>; National Institute of Food and Agriculture, "Precision Agriculture in Crop Production," United States Department of Agriculture, last accessed Oct. 1, 2023. <https://www.nifa.usda.gov/grants/programs/precision-geospatial-sensor-technologies-programs/precision-agriculture-crop-production>; "Research Overview," The AIFARMS Institute, last accessed Oct. 1, 2023. <https://aifarms.illinois.edu/research>; Naoki Nitta, "Welcome to the Next Generation of Agricultural Drones," Modern Farmer, June 19, 2023. <https://modernfarmer.com/2023/06/next-generation-agricultural-drones>; "Pivot Bio," Pivot Bio, last accessed Oct. 1, 2023. <https://www.pivotbio.com>.

### About the Author

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## FARM TECH NARRATIVE

### Bowery Farming: An Indoor Smart Farm

From the outside, the Bowery Farming facility near Baltimore, Maryland, looks indistinguishable from the other featureless industrial buildings and retailers nearby. But step inside, and the sharp, piercing scent of young lettuces and the mellow aroma of basil saturate the air.

Bowery, a high-tech indoor farming company, was founded by Irving Fain in 2015 in New York City. Today, it has seven high-tech farms in New Jersey, Pennsylvania and Maryland, in addition to a research and development facility. The Bowery farm in Bethlehem, Pennsylvania, is situated on an old brownfield site, giving new life and purpose to otherwise unusable land and creating much needed jobs for all education and skill levels.

From seed to salad, each detail of the process has been, and continues to be, optimized for maximum benefit to consumers and workers with minimum impact on the environment. Bowery's proprietary operating system (OS) easily guides employees and greens through a seamless production line that ends at the dinner table.

In the planting room, a smartphone-like device alerts a grower, in a clean lab coat, hairnet and booties, to the type of seeds to be planted in prepared trays. A computer-driven machine accurately deposits seeds into the growing medium. From there, seeds sprout in a warm, moist room that feels like a walk-in proofing cabinet. At each step, farmers can track which seedlings are ready to go where thanks to a unique code assigned to each tray of plants, which follows the plants throughout the process. Regular updates on each employee's device helps guide them to the next task as they oversee and assist the machines that do the heavy lifting: repotting, transporting from step to step, and finally settling into a vast hall of plants and light where the seedlings mature.

Here, multi-story racks crisscrossed with alley-like walkways hold countless—to all but the OS—trays of green plants in varying stages of growth. Computers ensure that each individual tray gets the proper type and hours of light through a constellation of multi-hued LEDs hanging just above the tray. Where a traditional farm would have soil, Bowery carefully measures and times nutrient-rich water—tailored to each product and stage of growth—that swirls



over the roots. Near the center, enormous air purifiers and circulators help maintain proper humidity, temperature and sanitation. Robotic scissor lifts move the heavy trays around the farm and into the packing area.

People assist the machines through the harvesting process, moving quickly from tray removal to root removal to chopping to washing and finally into low-waste packaging that helps extend the produce's shelf life. Then the produce is loaded onto delivery trucks that can take romaine harvested today to the produce section of a local grocery store in under 24 hours. More delicate herbs, such as basil, are harvested and packaged by hand.

Thanks to the lack of soil and rigorously controlled environment, along with the specialized tracking system, food-borne pathogens, which are often a concern with leafy greens and other produce, are kept to a minimum. Any problem with food safety or quality can be quickly identified and addressed without waiting for a new growing season or wasting an entire crop. Likewise, there is no need for potentially harmful pesticides. Bowery greens are safe to serve immediately out of the box without additional washing and drying.

Lettuces, other leafy greens and herbs are the main products grown at Bowery Farming. But the company is always looking for other foodstuffs that could benefit from their unique growing practices and business model that keeps consumers within arm's reach.

Strawberries are one of those highly anticipated products. Conventionally grown strawberries are limited to a large degree by seasonality. They bruise easily, particularly when allowed to vine-ripen, which creates harvesting and transportation challenges. But modifying them to grow out of season or shipping them unripe creates a flavorless and unappealing berry. Bowery spotted an opportunity to grow high-quality, mouth-watering strawberries year round and, in early 2022, launched two limited-release strawberry varieties.

With a change in farming policy, companies like Bowery farming could continue to grow and improve so that these types of products could appear on shelves across the nation.



## FARM TECH NARRATIVE

### EsBern-OM Holsteins: Robot Milkers



EsBern-OM Holsteins is nestled among the rolling hills of central Pennsylvania along the Susquehanna River. In an open-air barn, owner Olivia Platt finishes up some morning chores while her daughter, eight-year-old Katie, shows off her dairy cow, a young Brown Swiss, and points out the prettiest. The ones with the most spots are deemed the most photogenic—in particular, one named Sparkles.

Olivia was raised on a dairy farm two counties north. She planned to pursue a career in dairy herself and was fascinated by the technological advances being made in the field. When the opportunity came to build her own dairy from scratch, she knew she wanted to integrate the latest technology from the very beginning. It was an investment in her family and in the health of the cows, she explains.

Today, Olivia stays incredibly busy managing a herd of 50 primarily black and white Holstein cows. To help with the task, Olivia is assisted by a Lely Astronaut robot milker—a large red box with white lettering that gives the appearance of a modern, oversized refrigerator with a touchscreen.<sup>1</sup>

Though it required a significant capital investment on the front end, installing a robot milker and putting that technology at the center of her operations from the start helped Olivia avoid the disruptions that can come with phasing in such a critical component in a dairy farm's infrastructure and business model. The robot milker is housed in the nearly pristine free-flow barn, where cows can easily move from areas with food and water, to comfy compost bedding and finally to the milking stall.

When a cow feels like being milked, she meanders over to the open stall, which keeps her safely in place without feeling restricted or cut off from her friends.<sup>2</sup> There, a scanner reads her radio collar, immediately recognizing her ID. The primary mechanics of the Lely system are behind a wall in a mostly enclosed room with an opening at udder-level for the operational arm to get to work, first gently cleaning and disinfecting the udder, then attaching milking cups and sending fresh milk flowing to refrigerated tanks for pick-up.

While this is happening, the Lely robot is gathering reams of data on the cow: her yield, the quality of her milk (temperature, color and conductivity) and her health, which

all update to her file in real time. Each quarter of the udder is tracked separately, helping to pinpoint any potential problems such as mastitis (inflammation of the mammary gland/udder tissue that can lead to abnormal milk). The Lely system also makes it easy for Olivia to keep certain milk separate either because of temporary antibiotic use in a specific cow or a need to divert some for calves to drink.

The cow currently being milked is oblivious to the flurry of activity going on inches away. She is munching on her favorite food, a mix dispensed by the robot and tailored to her specific health and energy needs. As the cow calmly has her udders emptied, two more walk over and patiently get in line; the first one gently noses the gate. In just a matter of minutes, the ritual repeats itself for the next eager customer and will do so day or night, whenever the next cow wants to partake.

The brains behind this outfit is a desktop computer in a small, sunny room off the milking parlor. Taking in data from the Lely Astronaut just feet away, Olivia can monitor numerous key health factors for her herd. The collars are more than just an oversized ID bracelet; they are also a sort of cow pedometer, tracking her activity through head bobs and her rumination. Over time, this wealth of information can help Olivia track each individual cow's health, allowing her to get a jump on any potential problems when there is a change in pattern or an elevated factor, as well as accurately pinpoint when a cow is in heat. For Olivia and her cows, this knowledge and flexibility means peace of mind and body.

Although this robot revolution has been revolutionary in terms of labor and animal health, it is not a panacea for all the challenges of the dairy industry. Olivia shares how the change in ownership of a dairy processing plant over the mountains in Williamsport upended the local fluid milk market and transportation infrastructure, cutting off Olivia and her neighbors from their former customer base. Ongoing uncertainty about Farm Bill reauthorization and a flawed federal dairy support system only add to her questions about whether she should keep the venture afloat through herd expansion or perhaps reduce her herd and move into beef cattle. Still, systems like the Lely Astronaut are a technological marvel—one that permits Olivia to do more with her time, family and herd than the dairyfolk of previous generations could ever imagine.

1. "Lely Astronaut A5." <https://www.lely.com/us/solutions/milking/astronaut-a5>.

2. Krista Marie McLennan, "Social bonds in dairy cattle: the effect of dynamic group systems on welfare and productivity," University of Northampton, 2013. [http://nectar.northampton.ac.uk/6466/1/McLennan\\_Krista\\_2013\\_Social\\_bonds\\_in\\_dairy\\_cattle\\_the\\_effect\\_of\\_dynamic\\_group\\_systems\\_on\\_welfare\\_and\\_productivity.pdf](http://nectar.northampton.ac.uk/6466/1/McLennan_Krista_2013_Social_bonds_in_dairy_cattle_the_effect_of_dynamic_group_systems_on_welfare_and_productivity.pdf).