



Factory Farm Nation

2024 Edition



ABOUT FOOD & WATER WATCH

Food & Water Watch mobilizes regular people to build political power to move bold and uncompromised solutions to the most pressing food, water, and climate problems of our time. We work to protect people's health, communities, and democracy from the growing destructive power of the most powerful economic interests.

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Introduction

U.S. factory farms are raising more animals than ever before. Together, the 1.7 million confined animals produce an appalling 941 billion pounds of manure each year — double the weight in human sewage produced by the entire U.S. population. This manure is typically not treated before being dumped into the environment, where it fouls rivers and streams, pollutes drinking water, and fuels climate change.

And it is getting worse. Food & Water Watch's (FWW) analysis of data from the 2022 Census of Agriculture finds dramatic changes since the last Census five years earlier, including:

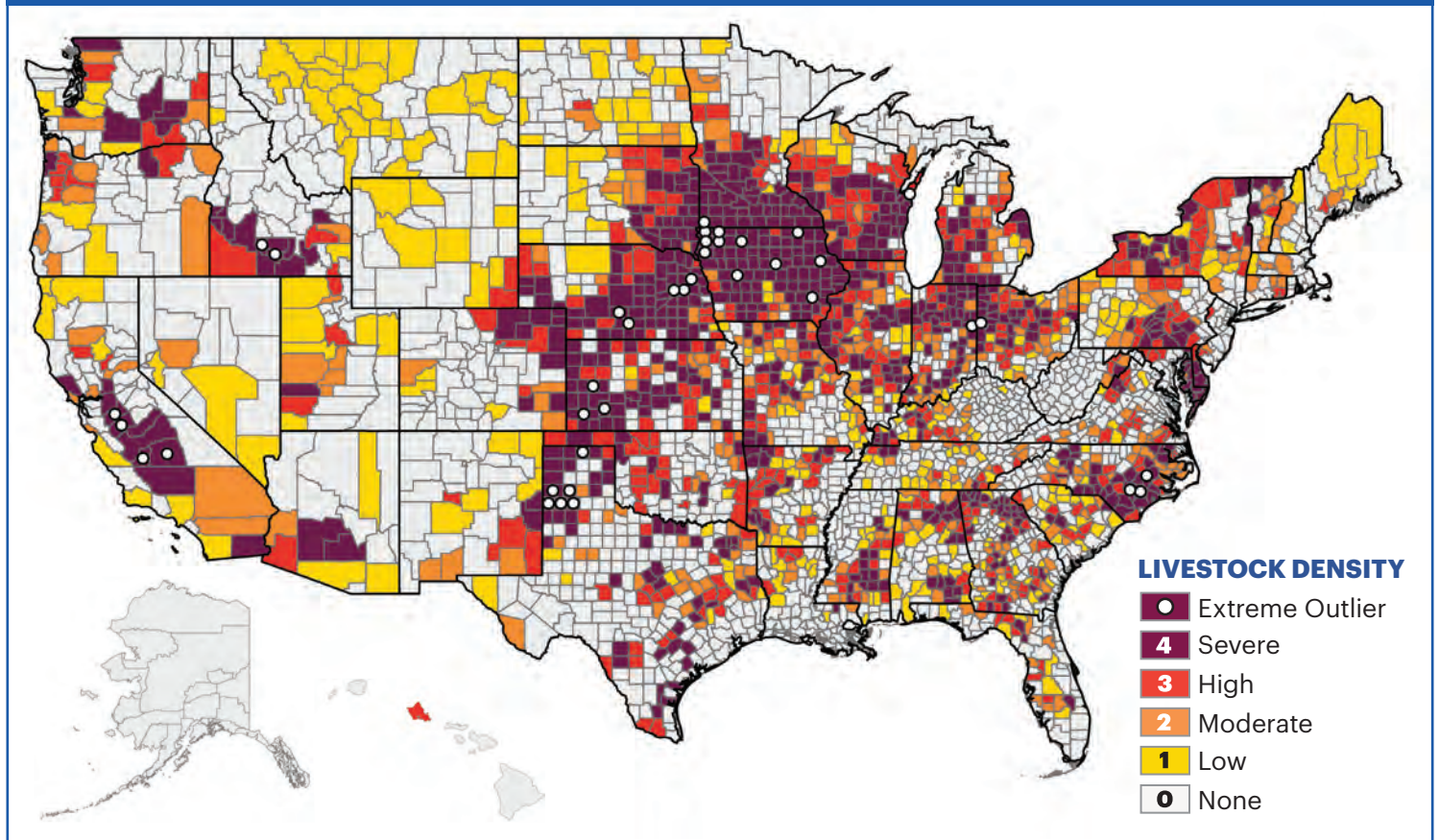
- Forty-nine additional counties ranking "Severe" for factory farm density (see Methodology);
- Ninety-seven million more animals living on factory farms — 6.1 percent more than five years ago, and 46.9 percent more than 20 years ago;
- Fifty-two billion *additional* pounds of manure generated annually, equivalent to the manure generated by nearly 39 million people (or the entire population of California); and

- Even larger factory farms as the industry continues to consolidate, with the average farm size increasing across nearly all livestock categories considered. Meanwhile, family-scale farms are collapsing, with the number of family-scale dairies falling by more than one-third from 2017 to 2022.

Big Ag's factory farm model — which treats farms as animal warehouses, farmworkers as expendable, and the environment as a dumping ground — harms us all, and especially those living next to them. This report documents some of the most egregious damages caused by factory farm expansion, including:

- **Polluted Water:** U.S. counties like Washington County, Iowa are overflowing with factory farm manure that threatens clean water. In 2022, Washington County's factory hog farms produced 4.8 billion pounds of manure — 156 times as much as the county's human population, and more than all Iowans combined.
- **Polluted Air:** Maryland's factory chicken farms in 2022 produced enough manure to fill an Olympic-sized swimming pool *each day*, while releasing a slew of toxic air pollutants and odors that plague nearby residents.

FIG. 1: All Livestock on U.S. Factory Farms, 2022



The evidence is clear: America's transformation into a factory farm nation erodes rural life, guts farmer income, pollutes air and water, exploits workers, disproportionately burdens environmental justice communities, and abuses animals.

FIG. 2: What Is a Factory Farm?



Beef cattle:
500 head on feed (feedlot)



Dairy:
500 cows



Hogs:
1,000 head



Broiler chickens:
500,000 sold annually



Egg-laying chickens:
100,000

- **Food Supply Disruptions:** Factory farms are ripe breeding grounds for pathogens like bird flu, which was blamed for spikes in egg prices in 2022 and 2023. While consumers pay more, corporations can rake in record profits; Cal-Maine (the U.S.'s largest egg producer) enjoyed a five-and-a-half fold increase in net income during fiscal year 2023 compared to the previous one.
- **Environmental Injustices:** While rural communities see their groundwater wells run dry, California's mega-dairies suck up 152 million gallons of water each day just to water and wash cows and buildings — more than enough water to meet the indoor water needs for the entire San Diego metropolitan area.
- **Gutted Farm Income:** As corporate consolidation has grown, so too have prices for ground beef, which are among the highest ever today, even when adjusting for inflation. However, farmers have seen their shares of retail beef sales fall from a high of 67.8 percent in 1973 to a low of 36.8 percent in 2021.

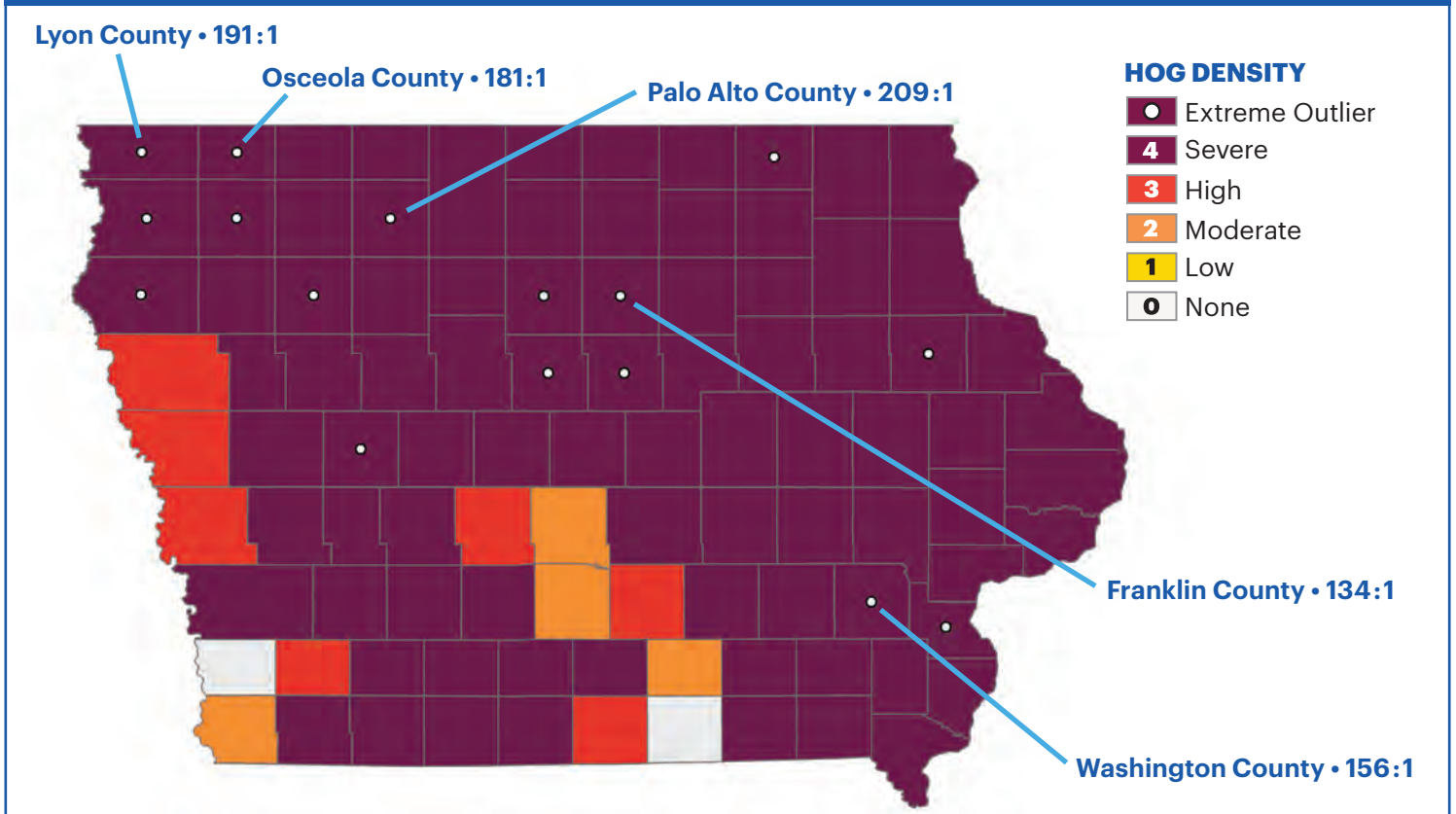
The evidence is clear: America's transformation into a factory farm nation erodes rural life, guts farmer income, pollutes air and water, exploits workers, disproportionately burdens environmental justice communities, and abuses animals. Factory farms are not inevitable; they are the result of policies and incentives that favor the agribusiness corporations that have a stranglehold on our food system. The U.S. needs a fundamental change in how we produce meat, dairy, and eggs, starting with an immediate ban on new and expanding factory farms. We must also revamp state and federal policies to build a fair food system that works for everyone — not giant agribusinesses.

Factory Hog Farms Pollute Our Water and Worsen Extreme Weather Events

Up until the late 20th century, most hogs were raised on smaller, diversified operations. But significant changes in U.S. farm policy and growing corporate power transformed the way we grow crops and raise livestock, leading to an onslaught of factory hog operations across rural America,¹ particularly in the Midwest and South. Today, the top 10 counties with the highest factory hog density are all in Iowa and North Carolina. Iowa alone confines one-third of U.S. factory-farmed hogs. Ninety-four percent of Iowa counties rank "Severe" or "High" for factory hog density (based on the number of livestock per square mile; see Methodology).



FIG. 3: 95 Percent of Iowa Counties Produce More Hog Than Human Manure
Hog-to-Human Waste Production Ratio, 2022



As each hog produces one-and-a-half tons of manure annually, the animals' combined manure in a county can meet or exceed the equivalent weight in human sewage produced by entire metropolitan areas (see Fig. 3). In 2022, hogs on Washington County, Iowa factory farms produced 4.8 billion pounds of manure — 156 times as much as the county's human population, and more than all people in Iowa combined. Unlike human sewage, hog and other livestock waste is not typically treated, and is often sprayed on farmland.²

Factory hog regions in Iowa and beyond can generate more manure than can be sustainably absorbed by

nearby cropland, contributing to runoff that pollutes soil and water.³ In 2021, American Rivers named Iowa's Raccoon River, which receives overflows from hundreds of factory hog operations, one of the country's "Most Endangered Rivers."⁴

Extreme weather events — which are getting stronger and more prevalent in our changing climate⁵ — contribute to major manure spills. In summer 2024, major flooding in the Midwest caused several manure lagoons to overflow into the environment.⁶ In 2018, Hurricane Florence led to extensive flooding of North Carolina's factory farms, drowning thousands of hogs



PHOTO BY KATHRYN GAMBLE

Iowa's Raccoon River snakes through hundreds of factory hog farms, receiving untreated hog manure runoff that pollutes nearby soil and water. Major flooding also causes manure lagoons to overflow, allowing polluted floodwaters to reach and contaminate nearby homes and drinking water wells.

and causing dozens of manure lagoons to overflow or breach entirely. Floodwaters can carry these manure pollutants downstream into flooded homes and neighborhoods, contributing to spikes in pathogens like *E. coli* in private drinking water wells.⁷

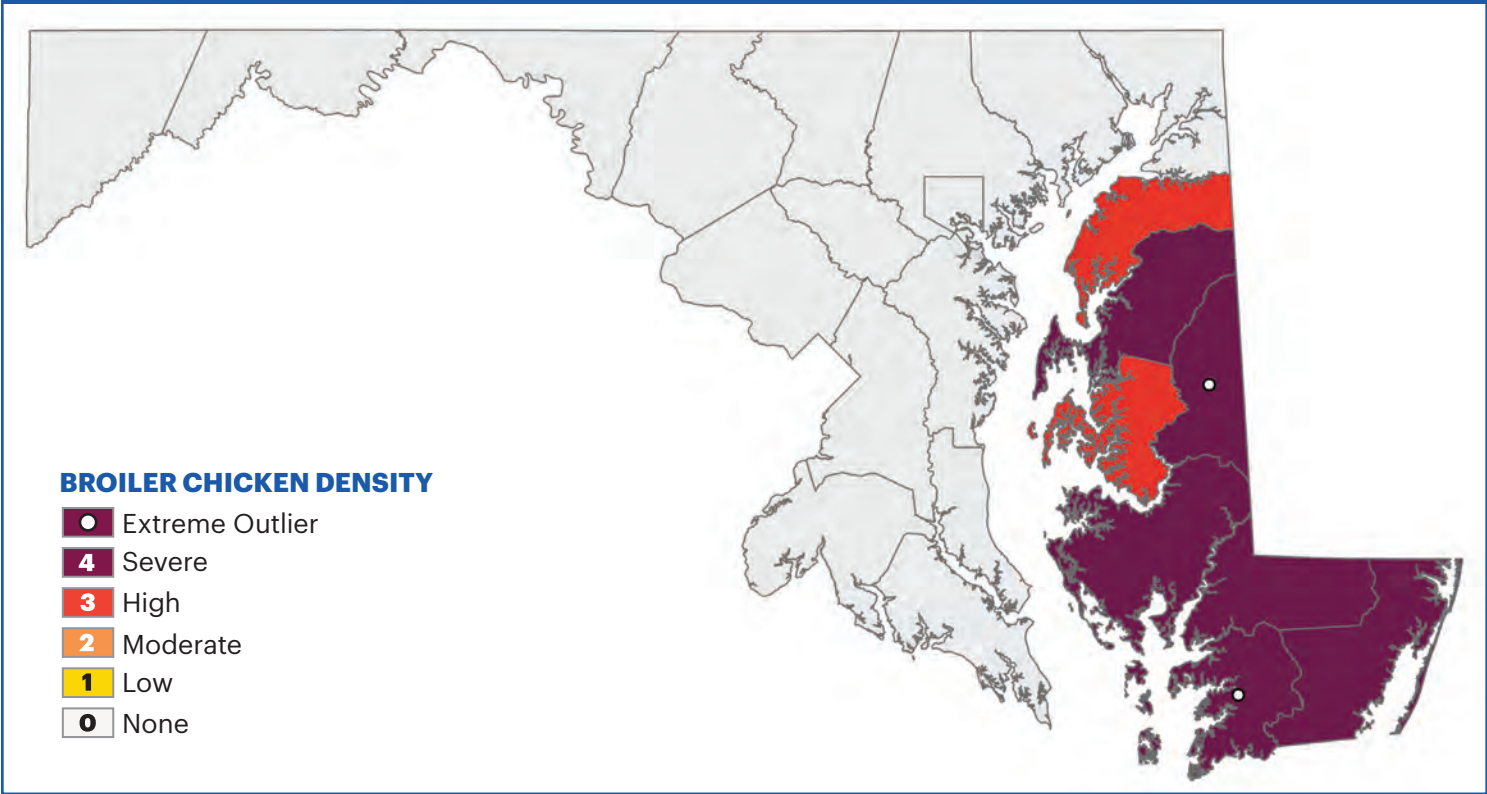
Contract Chicken Farming Pollutes Our Air and Abuses Farmers

Chicken farming is heavily concentrated in certain regions, including Maryland’s Eastern Shore (see Fig. 4), where communities live near factory farms housing hundreds of thousands of birds at a time. Factory chicken farms make bad neighbors, releasing foul odors that invade nearby homes and schools, even with the windows closed.⁸ The farms release a slew of toxic pollutants — including ammonia, particulate matter, and endotoxins — which irritate the respiratory system and are linked to lung disease. Industrial poultry houses also spread human pathogens and create volatile organic compounds that can harm the nervous system and contribute to toxic ground-level ozone.⁹

In addition, industrial poultry operations generate an enormous volume of poultry litter (a mixture of manure, feathers, and bedding).¹⁰ In Maryland in 2022, factory



FIG. 4: Broiler Chickens on Maryland's Factory Farms, 2022



chicken farms generated an estimated 548 million pounds of poultry litter. The manure content alone was enough to fill an Olympic-sized swimming pool every day. Poultry litter is high in nitrogen and phosphorus, and overapplication on fields can contaminate groundwater, polluting drinking water sources. Elevated levels of nitrate in drinking water are linked to the life-threatening condition known as “blue baby syndrome.”¹¹ Additionally, agriculture is the leading human-caused source of nitrogen and phosphorus pollution in the Chesapeake Bay.¹² Poultry litter contributes to this load, impeding efforts to restore this important estuary.¹³

The extreme concentration of factory farms in a region is all part of the poultry industry’s business model. Ninety-six percent of broiler chickens sold in the U.S. are raised under production contracts.¹⁴ In these systems, growers do not own the birds but instead raise them under contract with agribusinesses like Perdue and Tysons (the integrators), which lower costs by contracting with multiple growers in the same region.¹⁵ Agribusinesses shift many of the risks involved in raising chickens (as well as the burden of litter disposal) onto

the shoulders of growers.¹⁶ Integrators are able to offer such one-sided contracts in part because of extreme market consolidation, with limited numbers of integrators working with growers. Walking away is not necessarily an option when growers accrue massive debt to keep up with contract requirements.¹⁷

The Biden-Harris administration is targeting abusive poultry contracts as part of its efforts to strengthen protections under the Packers and Stockyards Act, initially enacted over 100 years ago to protect farmers and consumers from unfair and deceptive practices by the livestock industry.¹⁸ A rule proposed by the U.S. Department of Agriculture (USDA) in June 2024 would regulate “tournament” systems. These pit farmers against each other, rewarding some and punishing others based on how efficiently their chickens gain weight, which can be largely outside of farmers’ control.¹⁹ A stronger rule would ban such tournament systems outright. Ultimately, the USDA must prioritize providing resources for chicken farmers to break out of the contract system altogether and to raise and market their animals or crops on independent, sustainable farms.



Peeling back industry myths on factory farms and rural livelihoods

The factory farm industry likes to claim that its industrial model supports rural communities and creates jobs, and to stoke fears about job losses when opposing rules and legislation that challenge corporate power.²⁰ If this were the case, rural Iowa — ground zero for U.S. hog production — should be brimming with wealth and prosperity. Instead, Iowa serves as a tragic case study in the social and economic harms associated with factory farm expansion.

In 2022, the average Iowa hog farm sold 11,642 hogs — a 24-fold increase from 1982 (486 hogs). Over the same time, the state lost nearly 90 percent of its hog farms (see Fig. 5.). A FWW analysis explored how fewer farms

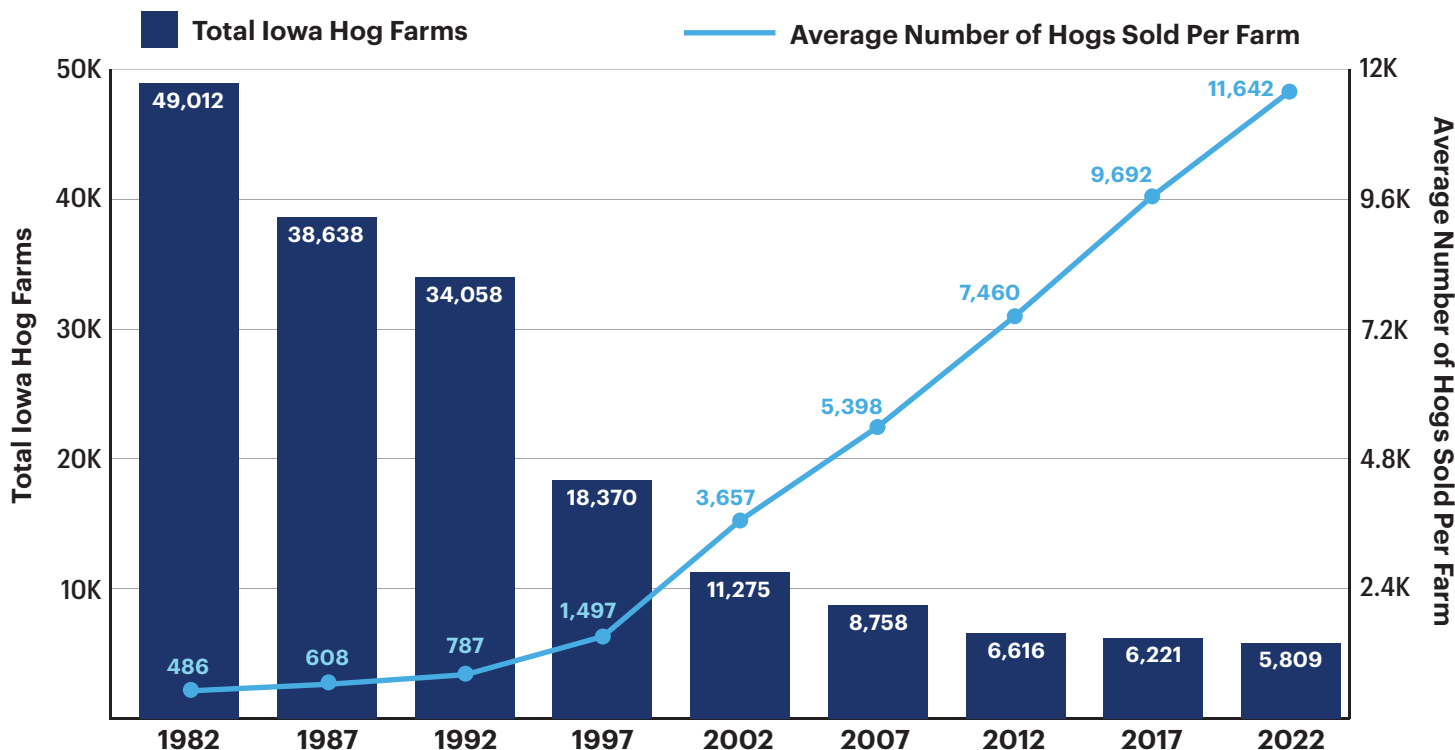
and ever-larger operations that contract with agribusinesses shift the economic power within farm communities.²¹ We found that the Iowa counties that sold the most hogs and had the largest operations experienced declines in real median income and population from 1982 to 2017, as well as losses in wage jobs and local businesses that exceeded the state average. In fact, Iowa had over 40 percent fewer farm jobs in 2017 compared with 1982, with even greater declines in counties with the most hogs sold and the largest hog farms — despite the state collectively selling 2.5 times as many hogs.

The economic gains from overproduction of hogs on factory farms appear to concentrate wealth

among the largest factory farms, which in turn tend to make fewer local purchases and hire fewer workers per hog sold than their smaller counterparts, creating cascading effects across the entire county. This hypothesis is supported by a growing body of research linking factory farm growth with declines in the economic and social well-being of communities, including higher levels of poverty and economic inequality, increased use of supplemental nutrition assistance, and out migration.²²

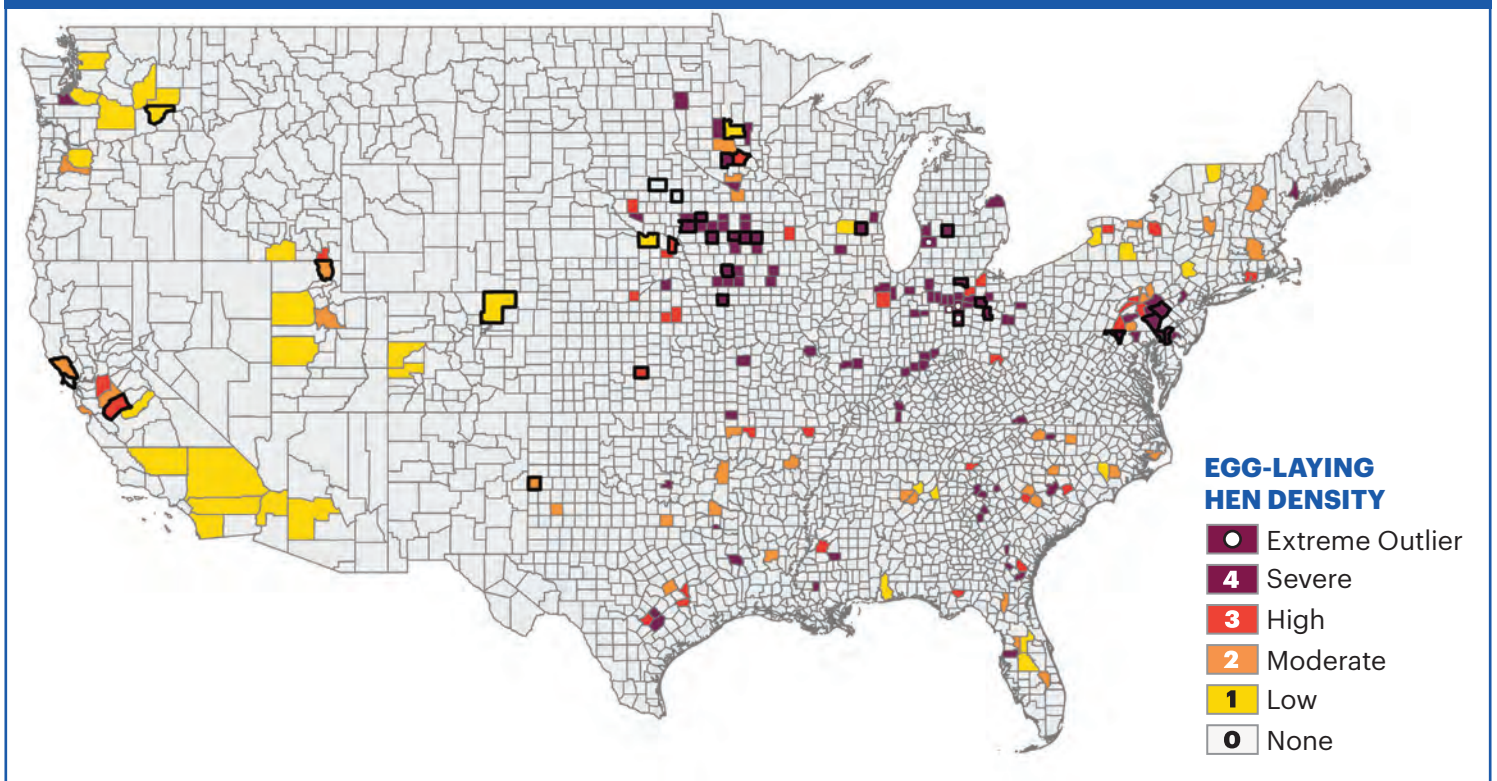
Simply put, the factory farm model is anti-farm and anti-farmer, and instead is just another means for agribusiness giants to extract wealth from rural America.

FIG. 5: Total Iowa Hog Farms vs. Hogs Sold Per Farm, 1982 to 2022



Source: FWW analysis of USDA

FIG. 6: Factory Egg-Laying Hens, 2022, and Bird Flu Outbreaks



Counties outlined in black reported bird flu outbreaks in commercial table egg flocks between March 2022 and May 2024. A significant number of these counties are, or are adjacent to, counties that also contain moderate to severe density of factory egg-laying hen operations.

Source: U.S. Centers for Disease Control and Prevention

Factory Egg Farms Contribute to Supply Chain Vulnerability and Threaten Worker Health

Nationally, the total number of egg-producing factory farms fell by one-third between 2002 and 2022, while the total hens on these operations increased, as factory farms got larger (see Fig. 6). The average egg-laying factory farm in 2022 confined over 800,000 hens, but facilities in top egg-producing states can confine a million or more. In May 2024, an outbreak of bird flu in a single Iowa factory farm led to the killing of the facility's 4.2 million hens.²³ Factory farms are incubators for zoonotic diseases and have been linked to the spread of human pandemics like the avian and swine flu outbreaks of the early 2000s.²⁴

The sheer magnitude of factory egg farms makes a single outbreak of bird flu all the more impactful, as does our highly consolidated food system, which is vulnerable to supply shocks and disruptions.²⁵ Average egg prices spiked to nearly \$5 a dozen in January 2023, compared to under \$2 a dozen one year earlier.²⁶ Cal-Maine, the U.S.'s largest egg producer, blamed bird

flu disruptions for charging wholesalers such high egg prices — while raking in a five-and-a-half-fold increase in net income in fiscal year 2023 over 2022. Cal-Maine in fact sold *more* eggs and did not experience an outbreak in its flocks during fiscal year 2023.²⁷ A Federal Trade Commission report slammed grocery chains for similar profiteering during COVID-19 related shortages.²⁸

Workers, meanwhile, risk exposure to bird flu, one of many workplace hazards inherent in factory farms, where conditions can be a nightmare. Long-term exposure to toxic poultry dust is linked to a slew of respiratory problems including chronic phlegm, asthma, and chronic bronchitis.²⁹ Injuries are another workplace hazard. The animal production industry as a whole (which includes workers raising animals on farms and feedlots) has an alarmingly high rate of non-fatal workplace injuries — the 2022 rate was 3.5 times that of the oil and gas extraction industry.³⁰ These figures only include reported incidents; workers may be reluctant to report injuries, especially undocumented immigrants, who often undertake the most dangerous jobs on factory farms.³¹

Bird flu is just one threat to hens on factory farms, where animal welfare takes a back seat to industry profits.³² State legislation and commitments from retailers have

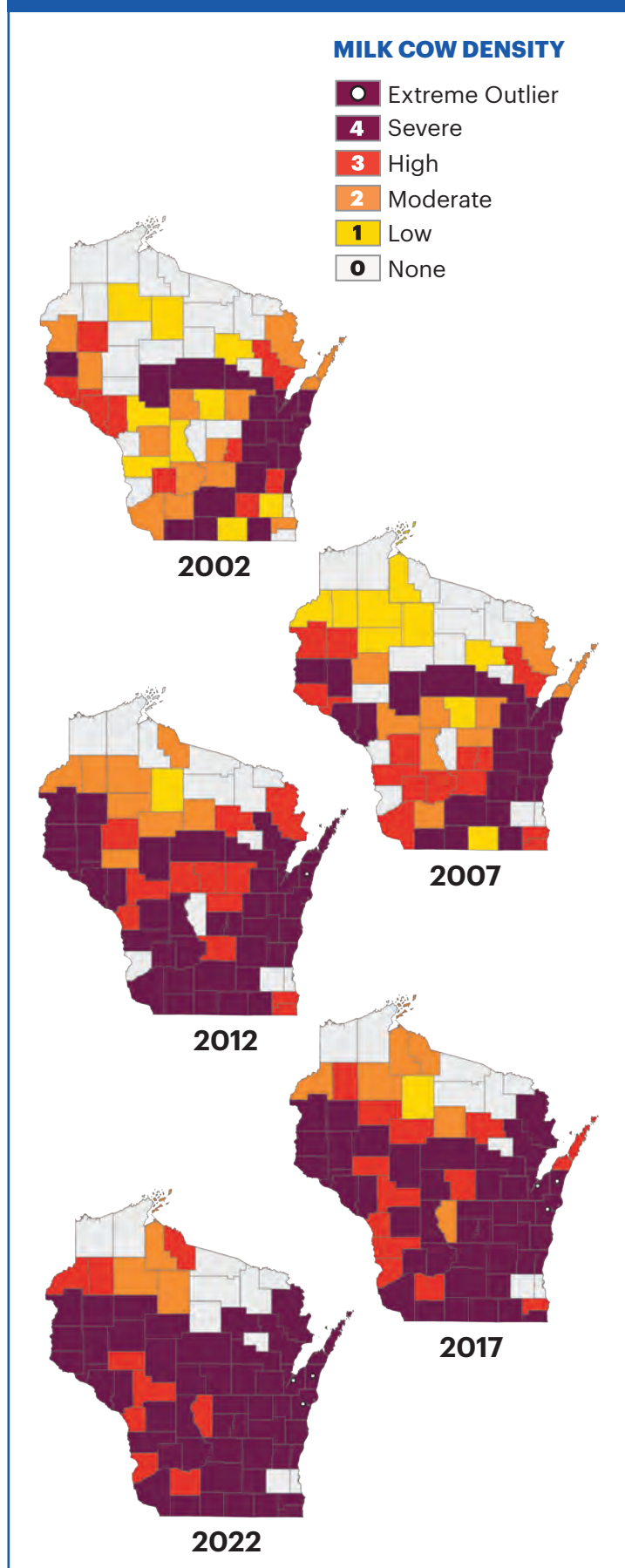
increased the availability of cage-free eggs,³³ yet the USDA's weak labeling requirements mean that a "cage-free" hen can still spend her entire life confined inside a crowded building.³⁴ The majority of U.S. egg-laying hens are still locked in cages, with as little as a piece of printing paper's worth of space per hen.³⁵ Industry practices like "debeaking" (done without anesthesia) cause lasting pain and stress.³⁶ Unsurprisingly, agribusinesses are largely resistant to any proposals to improve welfare conditions for workers and animals, and some even fight to preempt state regulations that provide modest improvements.³⁷ We cannot wait for industry to choose health and safety over profits; reform must come from revamping our federal agricultural policies that uphold the factory farm system.

Mega-Dairies Fuel Environmental Injustice and Climate Change

Nowhere is the shift from family-scale to factory operations more apparent than in the dairy industry, where consolidation occurred at a faster pace than in almost every other agricultural sector — a 16-fold increase in consolidation over just 30 years (1987 to 2017).³⁸ Wisconsin, for example, saw the number of cows living on factory farms (also called mega-dairies) more than quadruple in just 20 years (2002 to 2022) (see Fig. 7). At the same time, the U.S. is bleeding family-scale dairies. California, for instance, reported roughly half as many family-scale dairies in 2022 compared to just 2017, while the average number of milk cows per mega-dairy ballooned to 2,300. California now houses more milk cows on mega-dairies than any other state — twice that of Wisconsin, which ranks second.

Factory farms have long been disproportionately located in low-income and non-white areas.³⁹ For example, California's San Joaquin Valley — which houses 90 percent of the state's dairy cows — has a higher ratio of Latinx residents compared to California as a whole. Mega-dairies and other factory farms contribute over half of the region's emissions of ammonia, a toxic gas that causes respiratory issues. Ammonia reacts with nitrogen oxides (NO_x) (another mega-dairy pollutant) to form particulate matter, which is responsible for over 1,000 premature deaths annually in the San Joaquin Valley.⁴⁰ In addition to these health hazards, residents near mega-dairies and other factory farms report foul odors and flies that keep them from enjoying the outdoors or even opening their windows.⁴¹

FIG. 7: Growth in Wisconsin's Mega-Dairies, 2002 to 2022



Mega-dairies compete for water resources at a time when thousands of California's domestic water wells are running dry, and over a million Californians do not have access to safe drinking water.⁴² FWW estimates that California's mega-dairies require 152 million gallons of water each day just to water and wash cows and buildings. This is more than enough to meet the indoor water needs for the entire San Diego metropolitan area. This does not include the water needed to move manure into storage systems, or to produce animal feed, which encompasses the largest water footprint for milk production.

Mega-dairy pollutants also help fuel the climate crisis. Annual methane emissions from dairy manure management in the U.S. more than doubled between 1990 and 2022 despite overall dairy herd numbers staying relatively steady — thanks to mega-dairy practices like liquid manure storage that release significantly more methane than pasture-based systems.⁴³ Additionally, larger farms are less likely to graze their cattle on pasture and instead rely on purchased feed, which is the single largest source of livestock industry greenhouse gas emissions.⁴⁴



PHOTO CC-BY © SOM ENERGIA COOPERTIVA / FLICKR.COM

Anaerobic digesters: profiting from pollution

Agribusiness corporations are profiting from their climate pollution by producing and selling factory farm gas, greenwashed as “biogas.” Anaerobic digesters break down manure and other organic materials, creating a gas byproduct composed primarily of methane and carbon dioxide (CO₂) that can be used directly to produce electricity or heat, or “upgraded” for use as a transportation fuel.⁴⁵ Even if the technology were as efficient as the industry claims, it does nothing to address methane from enteric fermentation, the digestive process of cattle responsible for three times as many methane emissions than manure management in the U.S.⁴⁶

Moreover, digesters exacerbate existing environmental injustices. They can release air pollutants like NO_x and sulfur dioxide, which contribute to respiratory illness as well as smog and haze formation, respectively.⁴⁷ Digesters also do not erase livestock manure, which still needs to be disposed of (often on land); in fact, the use of digesters can enhance the ability of the waste to pollute water sources with nutrients like phosphorus and nitrogen.⁴⁸ Finally, the end product — factory farm gas — remains a dirty energy source that releases the same pollutants as fossil fuels when combusted.⁴⁹

On-farm digesters are prohibitively expensive for all but large factory farms, and they are often subsidized through significant public funding.⁵⁰ Programs like California's Low Carbon Fuel Standard gives fuels made from factory farm gas the lowest (and most lucrative) carbon intensity; this puts a premium on manure that can drive factory farm expansion, doubling down on pollutants plaguing over-burdened communities.⁵¹

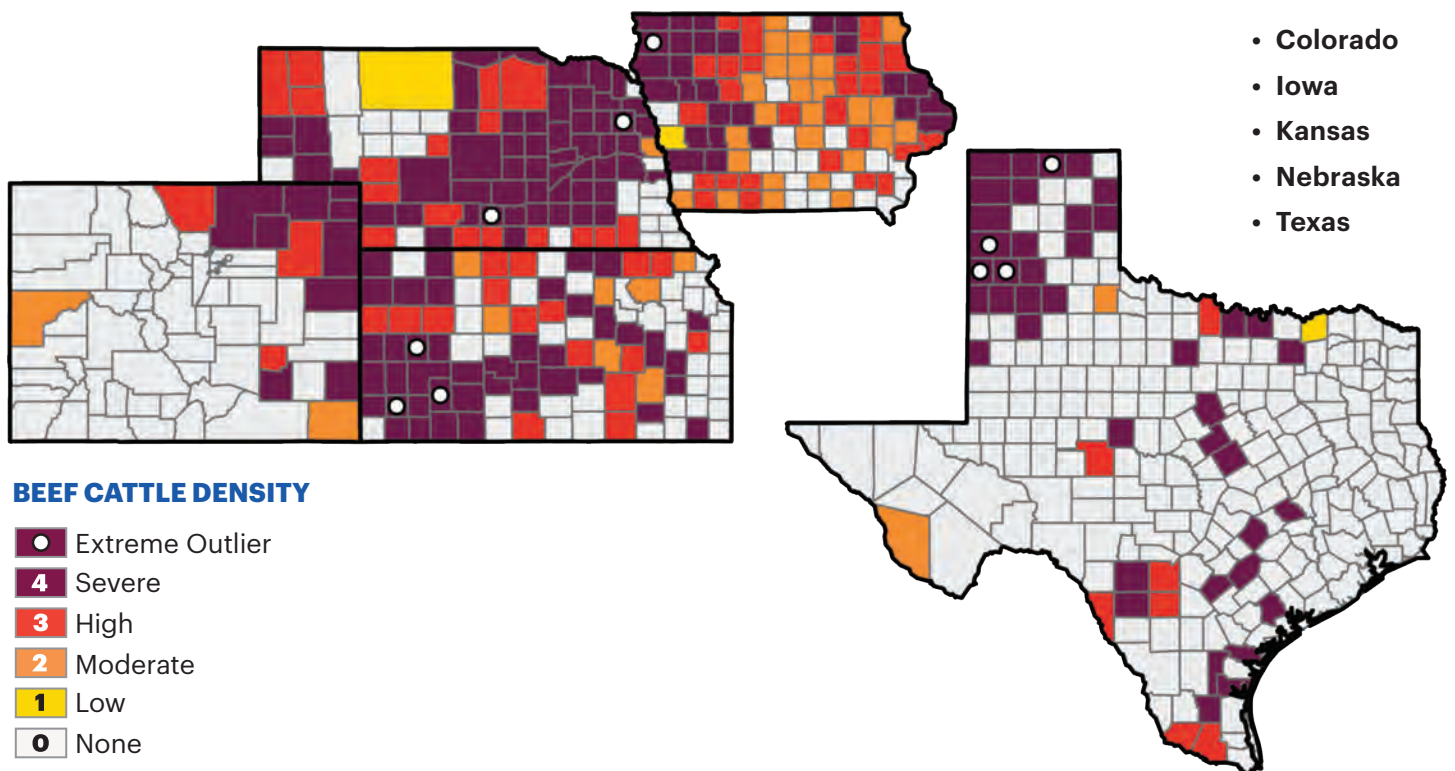


Mega-Feedlots Gut Farmer Profits and Raise Food Prices

U.S. beef cattle begin their lives on cow-calf operations — mainly on farms with fewer than 50 cows — before being sold to feedlots for “finishing.”⁵² Until the mid-1960s, the majority of beef cattle were finished on small “farmer-feedlots” where farmers raised their own feed.⁵³ Today, however, mega-feedlots dominate the market, with just five states accounting for three-quarters of all factory feedlot cattle (see Fig. 8). The average factory feedlot houses around 4,500 head of cattle, a figure that obscures the true extent of the problem. The USDA reports that half of U.S. beef cattle are finished on just 132 feedlots, each with a capacity of at least 32,000 head.⁵⁴ A feedlot of this size produces as much manure as a city of half a million people.

As feedlot size expanded, so too did the meat-packing industry’s stranglehold on the market. In 1980, the top four beef-packing firms slaughtered one out of three beef cattle; this increased to four out of five by 1995 and remains steady to this day. Local markets can be even more consolidated, leaving farmers with their hands tied, as transporting livestock between the feedlot and the slaughterhouse is expensive, limiting farmers’ ability to seek other buyers. This extreme consolidation can

FIG. 8: Just Five States Raise Three-Quarters of U.S. Factory Feedlot Beef Cattle



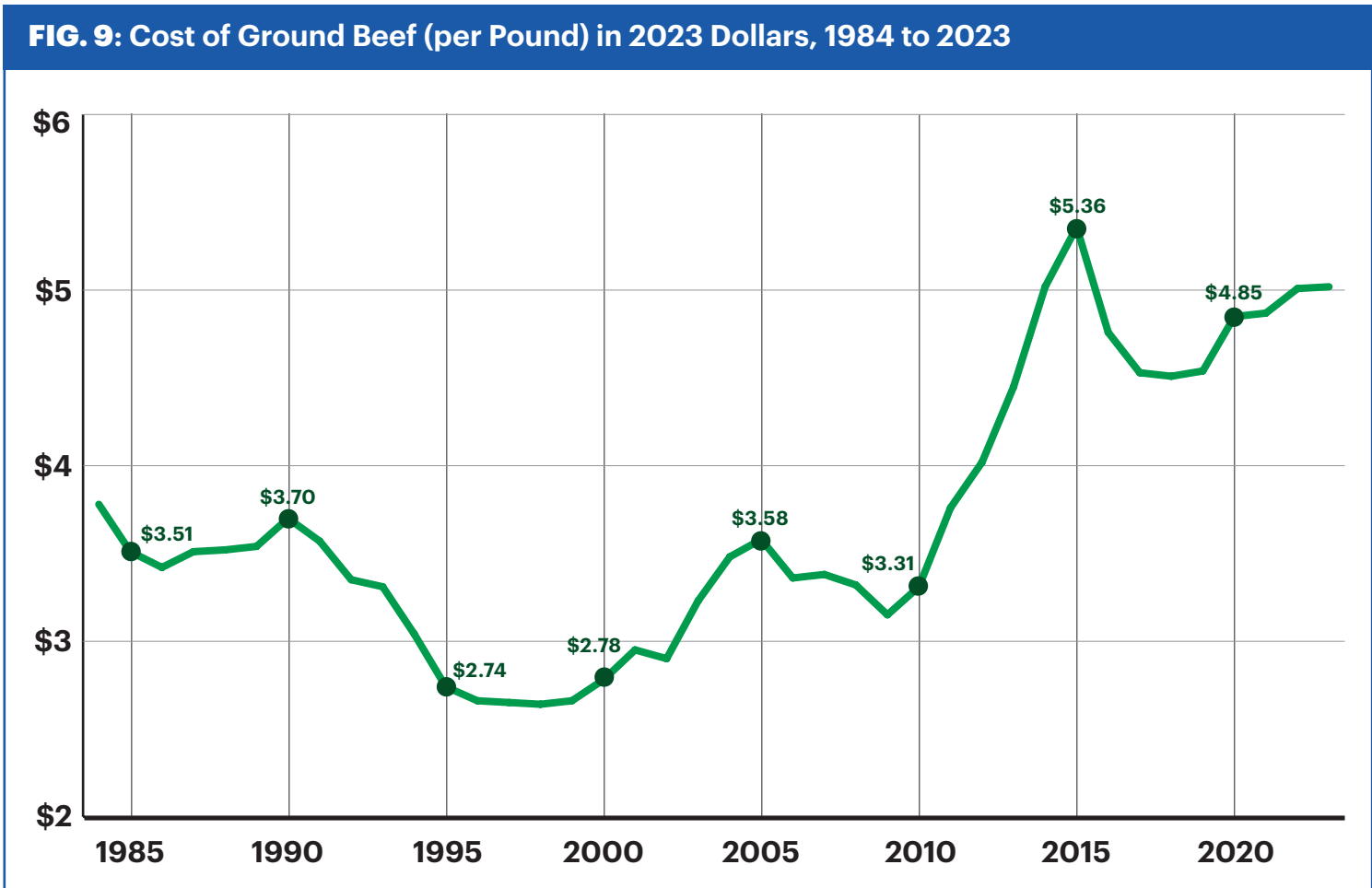
enable meatpackers to exercise greater control over livestock prices.⁵⁵ Unfortunately, federal regulations enacted over 100 years ago to protect farmers and ranchers in a highly consolidated market did not prevent further consolidation or these abusive practices.⁵⁶ The Biden-Harris administration's efforts to strengthen these protections under the Packers and Stockyards Act⁵⁷ are a necessary first step toward protecting farmers, but they are not enough; we need to enforce antitrust law and break up the meat conglomerates.

We can see this power dynamic play out in the farm-to-consumer “price spread” — the difference between what farmers earn and what consumers pay at the grocery store. This gap has widened in recent decades, corresponding with the rapid consolidation across the meatpacking and grocery retail industries.⁵⁸ Inflation-adjusted retail prices for ground beef today are among the highest ever recorded, averaging over \$5 per pound in the first four months of 2024 (see Fig. 9). Meanwhile, the farmers’ share of the retail value fell from a high of 60 percent in 1984 to a low of 37 percent in 2021. Consumers and farmers are getting fleeced, while giant meatpackers and supermarkets rake in record profits.⁵⁹

We Must Fight Corporate Power to End Factory Farms

Decades of failure to uphold our nation’s antitrust laws have enabled a handful of multi-national corporations to dominate every step along the food supply chain and to amass significant wealth. In turn, these powerful corporations collectively pour millions of dollars into lobbying elected officials on the Farm Bill and other policies that keep the factory farm status quo. Today, U.S. farm policy continues to incentivize the overproduction of commodities like corn and soybeans, providing artificially cheap feed for factory farms; meanwhile, public funding is flowing to factory farm projects like anaerobic digesters.⁶⁰ Moreover, polluting factory farms continue to evade regulation under our nation’s premier environmental laws such as the Clean Water Act and the Clean Air Act.⁶¹

The problem is bigger than any individual can solve alone. We need to elect leaders who are brave enough to fight back against corporate power, as well as to hold our elected leaders accountable when they do Big Ag’s



Source: FWW analysis of U.S. Bureau of Labor Statistics

bidding. And we need to organize and educate within our own communities on the countless harms of factory farms and the need for new farm policies that work for people and animals — not corporations.

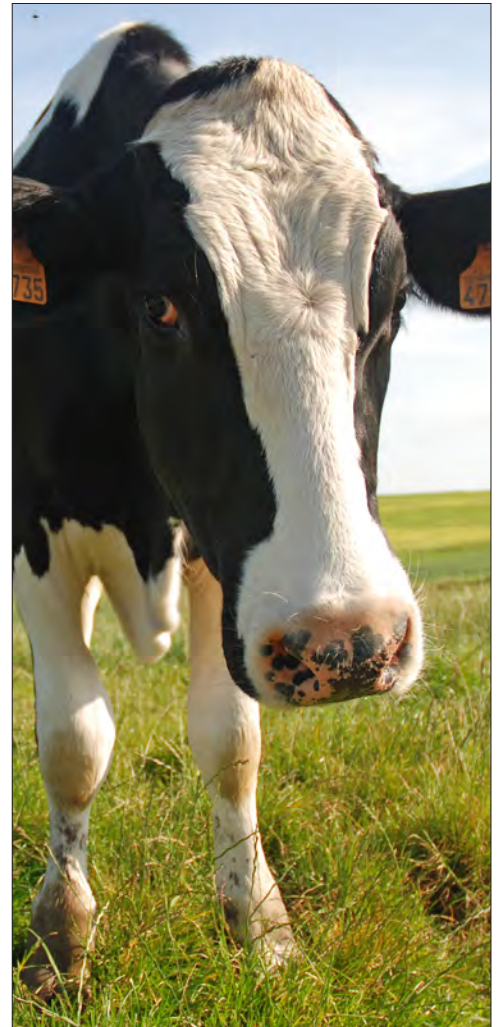
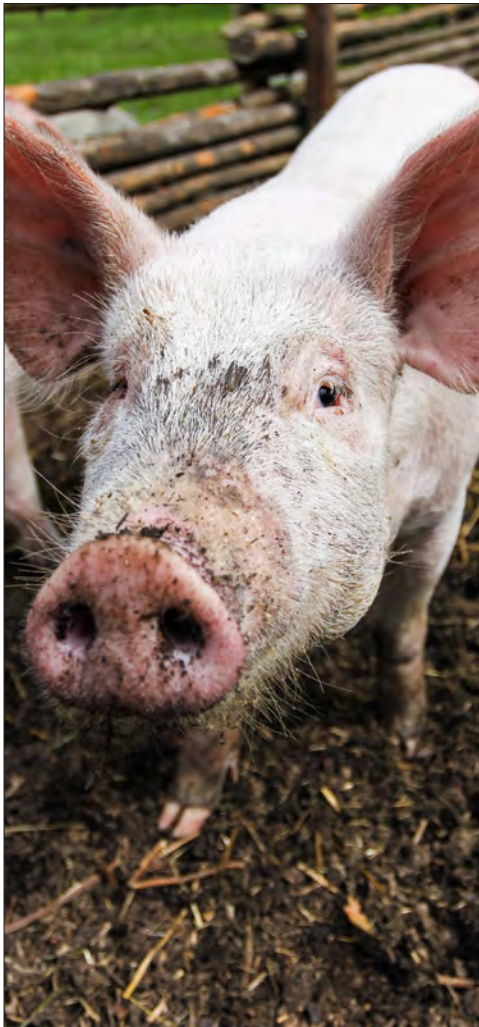
To create a just and sustainable food system, our elected officials must prioritize:

- An immediate, national ban on new factory farms and on the expansion of existing ones, with research and funding to help current factory farm operators transition to smaller, more sustainable crop and/or livestock systems;
- Investment to expand local and regional food markets and to build the infrastructure needed to help farmers bring their products to market;
- Reestablishing supply management controls, including the national grain reserve and price floors;
- Expanding crop insurance and other subsidies to cover more crops that directly feed people;
- Closing loopholes — like guaranteed loans and

conservation payments — that allow factory farms to hijack public funds;

- Enforcing Clean Water Act and Clean Air Act regulations with respect to livestock operations;
- Enforcing antitrust legislation with respect to agribusinesses; and
- Rejecting false solutions like factory farm gas (greenwashed as biogas).

Ending factory farms will shift our food economy to embrace more regional, diverse food choices. Consumers who choose to eat meat can embrace a “less-is-better” approach, choosing high-quality meat, dairy, and eggs from local producers — a win-win-win for consumers, farmers, and the planet. However, we cannot shop our way out of this problem. We need to vote for candidates who share this vision of a more just and sustainable food system — and who are willing to take on the agribusiness giants that are only out to promote their corporate interests.



Methodology

Data collection

Food & Water Watch (FWW) compiled data from the five most recent U.S. Department of Agriculture (USDA) Census of Agriculture reports (2002, 2007, 2012, 2017, and 2022), a comprehensive survey that includes data on livestock inventory, number and size of operations, and livestock sales, among many others, down to the county level.

We classified operations as “factory farms” if they met the following Census categories: 500 or more beef cattle on feed, 500 or more milk cows, 1,000 or more hogs, 500,000 or more broiler (meat) chickens sold annually, and 100,000 or more egg-laying hens. (For the broiler category, we first divided the county sales in the given year by 5.5 — the approximate number of flocks raised annually per operation — to get an estimated inventory at any given time.⁶²) These categories roughly align with the U.S. Environmental Protection Agency’s size criteria for medium-sized concentrated animal feeding operations (CAFOs).⁶³ In this report, “family-scale” farms refer to operations with inventories smaller than these benchmarks.







The USDA does not report county-level inventory and sales data for broilers and layers by farm size. Instead, we first used state-level data to calculate the average inventories and sales per factory farm. We then applied the state average to each operation within a state’s counties before calculating its county-level inventories. Similarly, we applied state-wide averages in instances

where the USDA withheld inventory figures for factory operations within a given county (in order to protect the identities of operations in counties where few exist).⁶⁴

For the “All Livestock” category, we first converted inventory data into animal units, a weight-based measurement that is used to aggregate livestock inventories across various animal types. Animal unit measurements vary slightly among different state and federal agencies. For this report, we use the USDA’s definition of one animal unit equaling 1,000 pounds of live weight, which amounts to 1.14 feedlot beef cows, 0.74 dairy cows, 9.09 hogs for slaughter, 455 broiler chickens, and 250 laying hens.⁶⁵

Density rankings

In previous factory farm map releases, we used county-level inventories of factory-farmed animals as the basis for our density rankings. We updated the methodology to account for the size differences between U.S. counties, first dividing livestock inventories by county area to arrive at the average animals per square mile (livestock density) and rounding these figures to 3 decimal places. We calculated the quartile distribution of county livestock densities greater than zero for each livestock category in 2002, assigning counties with ranks from “Low” to “Severe,” and assigning counties with no livestock on factory farms “None.” We used the 2002 quartiles as the basis for subsequent Census year rankings to highlight the growth of factory farms over time. We gave any counties and county-equivalent areas not reported individually in the Census^a a default ranking of “None” (see Fig. 10).

FIG. 10: Factory Farm Map Density Table									
Density Rankings				Animals per Square Mile Distributions					
Quartile*	Density	Map Color		All Livestock (Animal Units)	Beef Cattle on Feed	Milk Cows	Hogs	Broiler Chickens	Egg-Laying Hens
Top 1%**	Extreme Outlier		Dot	136.565	199.462	67.587	669.025	18,668.236	9,391.013
4	Severe		Dark Red	396.918	452.487	145.316	2,632.689	41,943.707	31,739.502
3	High		Red	16.353	16.522	4.618	70.802	3,695.490	1,700.257
2	Moderate		Orange	6.743	6.077	2.264	30.414	1,511.009	1,140.061
1	Low		Yellow	2.555	2.045	1.295	12.923	546.454	607.225
N/A	None		Gray	0	0	0	0	0	0

* Values to the right are the upper boundary of each quartile. For example, the 1st quartile for hogs ranges from >0 to 12.923 hogs per square mile.
** Values to the right are the lower boundary for the top 1%. For example, the top 1% for hogs includes all counties with at least 669.025 hogs per square mile.

^a Alaskan counties are reported together in groups, but none reported factory farms for the livestock categories and years covered in this report. Kalawao County is included in Maui County, Hawaii, which reported only one factory farm over this report’s time frame (a hog farm of undisclosed size in 2002).

Quartile distributions often do not account for significant outliers. For example, the fourth (“Severe”) quartile for hogs on factory farms includes those counties with livestock densities of 70.8 hogs per square mile or more; however, a handful of counties in Iowa, North Carolina, and Minnesota exceed 1,000 hogs per square mile. To highlight these regions of extreme factory livestock density, we calculated the top 1 percent of counties by livestock density for each category in 2002, and kept these same benchmarks across subsequent Census years to highlight worsening concentration. We displayed these as “Extreme Outlier” points on our maps (see Fig. 10).

Mapping

We built the maps in ArcGIS Pro, using feature layers from ArcGIS’s Living Atlas of the World to display U.S. counties⁶⁶ and state boundaries.⁶⁷ We joined the county feature layer to tables that included our density rankings. We then displayed county density codes by assigning a unique color to each ranking category. We added a point layer indicating the county “outliers,” or those that would qualify as in the top 1 percent based on the 2002 Census distribution. We then shared these maps on ArcGIS Online and edited the styles for usability.

Manure production and human sewage equivalencies

FWW previously relied on estimates for livestock and human manure production from a 2004 EPA factory farm risk assessment.⁶⁸ Beginning with the 2020 map release, we updated our calculations on livestock manure production using the most recent agency estimates we could find — specifically, a 2013 EPA report that employed USDA methodologies.⁶⁹ The estimates for livestock manure production by weight were nearly identical to those in the 2004 EPA assessment, and were used when estimating the total weight or volume of manure produced by all five livestock categories.

When considering broilers alone, we calculated litter production (the combination of manure, feathers, and bedding from chicken houses) using estimates developed for the Chesapeake Bay Foundation.⁷⁰ As this methodology relates only to broiler (meat) chickens, we did not apply it to egg-laying hens.

Beginning with the 2020 report release, FWW stopped using the 2004 EPA assessment to estimate human manure production, as this considers only fecal matter, whereas the EPA’s livestock estimates include both urine and feces, creating an insufficient comparison.⁷¹ Instead, we used the most recent estimate of human manure (urine and feces) production we could find referenced in an agency document, a 2008 Government Accountability Office report.⁷² This lowered the livestock-to-human waste ratios from previous map iterations and reports. We continued to use the U.S. Census Bureau’s American Community Survey 5-year estimates in comparisons of county-level livestock waste production to human populations of counties and major metropolitan areas.

Water use by mega-dairies

FWW used variables from Mekonnen and Hoekstra (2012)⁷³ to estimate the total lifecycle water use needed to produce milk at industrial-scale dairies in the U.S. (This estimate does not include water used to flush manure into storage systems.) Feed production encompasses the most significant water footprint for animal products (98 percent), but as feed may be imported from off the farm, we focused on the immediate water use of mega-dairies like watering cows and washing facilities.⁷⁴ We compared these figures to the State of California’s target of 42 gallons per person per day for residential indoor water needs.⁷⁵

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