THE FOOD SYSTEM:
CONCENTRATION AND ITS IMPACTS

A Special Report to the Family Farm Action Alliance

by

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Highlights

- Consolidation is happening across all sectors in the food system, at the national and global levels, and has resulted in a particular set of power relationships. This has resulted in numerous negative impacts on farmers, workers and their communities as well as consumers, who have experienced higher prices and less innovation.
- These power relationships impact our food system democracy, and are particularly concerning for marginalized voices and communities.
- Crop acreage is consolidating in larger farms, while the sales midpoint for livestock has starkly increased between 1987-2017. For hogs, the midpoint of sales has increased from 1,200 to 51,300 and in dairy the herd size has gone from 80 to 1,300 cows.
- New processes of integration are occurring. In U.S. pork production, large pork producers own processors and grain elevators, while supermarket behemoths Walmart and Costco are using backward integration in dairy, beef and chicken. Kroger continues its strategy of backward integration in dairy and is supplying competing retailers. In addition, asset management firms are increasing their investments in food and agriculture, potentially reducing competition via common ownership of most of the leading firms in a number of industries.
- In a consolidated system, farmers, workers and the environment are interconnected, meaning that when problems hit one part, they quickly engulf others. For meatpacking, the coronavirus hit workers, and the human tragedy of over 40,000 workers with COVID-19 (189 deaths) quickly became a farm and environmental disaster. Besides the financial hit for farmers who may have euthanized between 300,000 to 800,000 hogs and 2 million chickens, the waste of the embodied resources (28,500 tons of pork, .02% of the 2018-2019 corn crop) is stunning. The inability to control the drift of the herbicide dicamba has divided communities, damaged livelihoods and ecologies, and illuminated the inability of agencies to regulate dominant firms.
- Agrifood consolidation reduces farmer autonomy and redistributes costs and benefits across the food chain, squeezing farmer incomes. In 2018, farmers whose primary occupation was farming but with sales of less than $350,000 had a median net income of -$1,524. An agriculture without people has depopulated rural communities causing a collapse in social relationships. Communities of color bear a disproportionate burden of exposure to excessive pesticide use or large animal confinement operations.
- Consolidation obscures ownership to the point that farmers and consumers frequently have far fewer options in the market than it appears. For instance, Anheuser-Busch InBev (Belgium) has acquired 17 formerly independent craft breweries since 2011, although these ties are not indicated on the product labels. Seed companies label the same seeds under multiple brands while products from a single processing plant may be sold under as many as 40 different brands.
- Because political democracy rests on economic democracy and vice versa, our laser focus in scholarship, praxis and policy must be on democratizing the agrifood system at local, state, regional and national scales. Working together, policy-makers, farmers, workers and communities need to fashion alternatives and policies that can help to curb monopolistic tendencies in the agrifood system, to shine a racial lens in scholarship on agrifood system power and consolidation, to prioritize resilience and redundancy, to rethink core assumptions such as efficiency and property rights, and to encourage the development of alternative production and consumption arrangements.

Introduction

In this paper, we report the current state of concentration in the food system in the United States and globally, examine the consequences of that concentration – which have become very evident with the COVID-19 crisis – and suggest avenues for action and transformation of thfe food system. Our collective scholarship has long been concerned with increasing concentration in agriculture and food because of the impact of the associated economic and political power has on democracy, equity, ecology and community.

In the last 150 years of relatively temperate and stable climate, we have come to rely on a high-yielding, mechanized, capital-intensive system of agriculture and food that operates at a global scale, impacting local places around the globe unevenly. Lyson (2004) succinctly illustrated how technological revolutions including mechanization, the use of chemicals, and biotechnology made agriculture more specialized, disconnecting food production and consumption from particular places and their communities. Big data/digitalization of agriculture continues this trend (Mooney 2018; Rotz et al 2019). These revolutions tend to deskill agrifood labor, rewarding the most powerful firms and exploiting vulnerable labor forces. Our fossil-fuel dependent transportation systems have enabled regional specialization across the globe – for example fruit and vegetable specialization in places such as Spain, Kenya or Mexico, or highly industrialized grain production in the American Midwest or Eastern Europe. These processes have have altered producers' relationship with their land and communities, often marginalizing the labor process across the food chain, and changing the relationship of consumers with food acquisition and preparation – transforming ecological and community relationships in the process.

These changes have paved the way for the current social and economic structure of our agrifood system. A capital-intensive system rewards those with access to capital (that is money), and marginalizes those without it. This has become particularly important in an increasingly unequal society, where money and power have accrued to a few, predominantly white households, with agriculture following the same trends. More importantly, money and wealth that is increasing concentrated in the hands of a few risks the notions of dispersed power at the center of Western democracies (Wu 2018).

This concentration of ownership, wealth and power is particularly apparent in the agrifood system where just a few companies dominate almost all aspects of food production. The social and ecological risks associated with our current agrifood system – rising levels of food insecurity and hunger, ecological degradation – are directly related to who has the power to make decisions in food and agriculture. Who decides where and what food will be produced, who produces it and how, and who will get to eat it? We observe that these decisions have increasingly migrated from a more community or public arena (c.f. Weis 2007;Wilkinson 2017) into the realm of private decision-making that largely involves those within the biggest firms, including their management teams, boards of directors and shareholders. Those decision-makers have their eye on increasing their power relative to other firms, and although this may increase their profits, it does not usually align with enhancing the public good. We need only look at the agrifood sector during the COVID-19 pandemic. In a time where the World Food Programme warned that the number of hungry people in the world will double to 270 million people[1] and dairy farmers dumped

[1] https://www.wfpusa.org/coronavirus/

their milk while facing bankruptcy,[2] grain traders like Bunge and ADM reported healthy profits[3] and privately held Cargill returned record profits to the family that constitutes their shareholders'[4]

Consolidation and concentration are key features across the food system, from aggregating farmland holdings to seeds and fertilizers to processing and manufacturing to distributing and retailing. We have seen horizontal, vertical and global integration within and across the supply chain, across commodities and food sectors, and at multiple scales – from regional markets to global markets. The food system is not unique in the way capital and decision-making is concentrated. Studies show that concentration is a systemic rather than isolated feature of the broader economy, and within agrifood itself (Hendrickson, Howard and Constance 2019; Khan 2020). Recent authors of *The Curse of Bigness* (Wu 2018) and *Goliath* (Stoller 2019) argue that concentrated political and economic power threatens our democracy and must be addressed. From our perspective, it may be even more urgent to address within the agriculture and food system, both in the U.S. and globally, in order to ensure that humanity can be fed in the future.

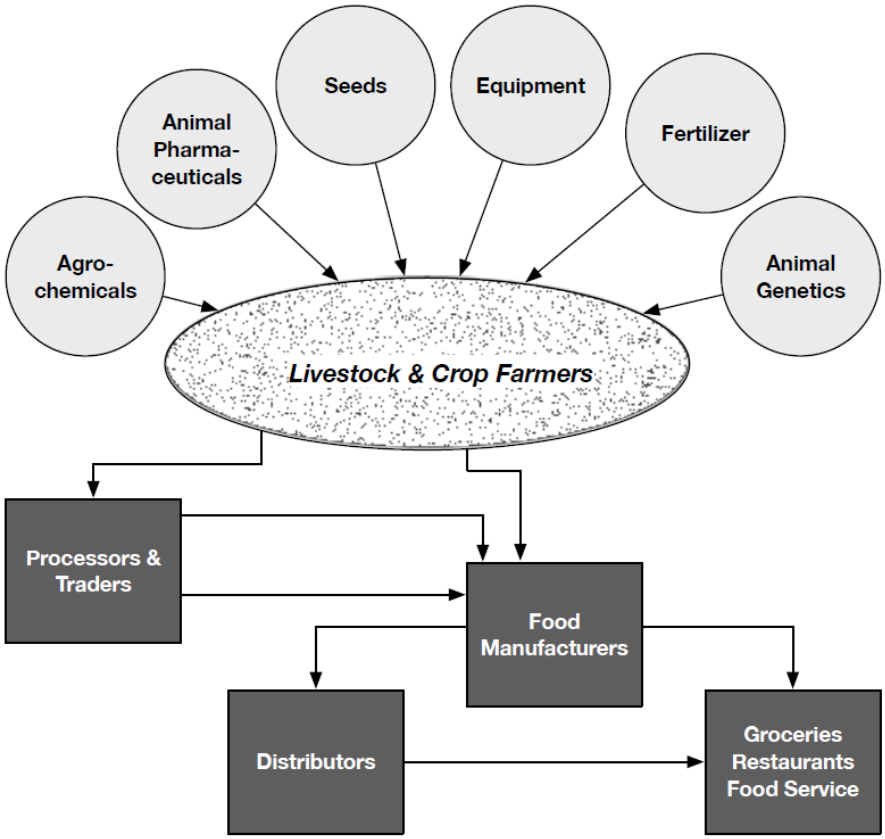

Figure 1: Illustration of different points of consolidation and control in the agrifood system. There are officially close to two million farms in the U.S., but less than half of them consider farming their primary occupations.[1] Still, these million farmers must buy seeds, fertilizers and chemicals from the same few firms as many farmers around the world do, while selling to just a few food processors and traders who operate in the U.S. and globally, who then move food further down the supply chain until it eventually winds up in a grocery store where a majority of us purchase our food.

The distribution of power in the food system, embodied in the power to make decisions about what food is produced, how, where and by whom, as well as who gets to eat – and what they get to eat, is our major focus of concern because of the negative impacts of those decisions to farmers, workers, communities and our ecology. Without a rebalancing of economic and political power within the global food system, humanity confronts a crisis over our very sustenance.

[2] See https://www.detroitnews.com/story/business/2020/07/03/dairy-farmers-dumping-milk-worldwide-brink-crisis/5372654002/ or https://www.cnn.com/2020/06/08/perspectives/cabot-dairy-farmers-pandemic/index.html

[3] See *Successful Farming:* https://www.agriculture.com/markets/newswire/grain-trader-adms-profit-doubles-on-boost-from-agri-nutrition-businesses and https://www.agriculture.com/markets/newswire/update-3-bunge-raises-outlook-as-robust-agribusiness-powers-profit-beat

[4] https://www.bloomberg.com/news/articles/2020-07-31/cargill-pays-record-dividend-to-family-owners-after-profits-boom

Current State of Concentration in Key Products and Market Channels

Recent years have seen continued consolidation in numerous food and agricultural industries. These patterns stem from mergers and acquisitions among formerly separate firms, as well as the exit of other competitors. The result is more concentrated markets, or sales that are dominated by fewer and larger firms. A simple measure of concentration is a ratio, typically the combined share of the top 4 firms, or concentration ratio 4 (CR4). A limitation of the CR4 is that it only measures horizontal changes, and firms are increasingly integrating vertically, such as by acquiring upstream suppliers or downstream customers. In addition, leading firms are rapidly integrating globally, and it is more challenging to measure concentration worldwide than in a single national market.

One significant result of these changes is increasing foreign ownership of formerly U.S.-headquartered firms, sometimes with substantial foreign government support. Another is that firms have become dominant across industries previously separated in ownership, such as seed and agricultural chemical sales, or processing of beef and soybeans. This has been accompanied by rapid trends toward larger farms and a declining number of farms. In this section, we show consolidation in key livestock and crop sectors, as well as levels of concentration for key products and market channels in both the US and global arenas.

Agricultural Inputs and Data at the Global Level

There are approximately 2 million farmers in the US, but most of them buy inputs from a very small number of firms. These are the same firms that millions more farmers around the world increasingly rely on – especially for agrochemicals, animal pharmaceuticals, seeds, farm equipment and fertilizers. The leading firms and their global market shares are shown in the figure below. Four out of five of these input industries have a CR4 of over 40%, a level that may be conducive to price signaling when observed in national markets – but we emphasize that these firms are now dominant in *global* markets. National and more specific market segments may be even more concentrated, such as the two leading firms combining for 70% of corn and 61% of soybean seed sales in the US (Maisashvili et al. 2016), or the leading firm controlling more than half the sales of heavy tractors and combines in the U.S. (Horton and Kirchmeier 2020).

Recent changes in the agrochemical industry have reduced the number of dominant firms from six to just four, and ownership has changed from three U.S.-headquartered firms to just one. Since 2015, the U.S. firms Dow and DuPont merged and spun off an agriculture focused firm named Corteva, ChemChina acquired Syngenta (Switzerland), and Bayer (Germany) acquired Monsanto (U.S.) and divested some seed divisions to BASF (Germany). Note that all four of these remaining firms are also dominant in seeds – BASF is currently ranked the fifth largest in global seed sales.

Other inputs that farmers rely on include animal genetics from large seedstock banks used both by integrators and farmers breeding by artificial insemination. Although this industry is much smaller in comparison to those discussed above – approximately $5 billion in annual sales – it is even more concentrated. Globally, just two firms control 99% of turkey genetics, 94% of laying hen genetics, and 91% of broiler genetics, and just three firms control 47% of swine genetics (ETC Group 2013; Shand and Wetter 2019). Two European firms, EW Group and Hendrix, are each among the top firms in three out of four of these species.

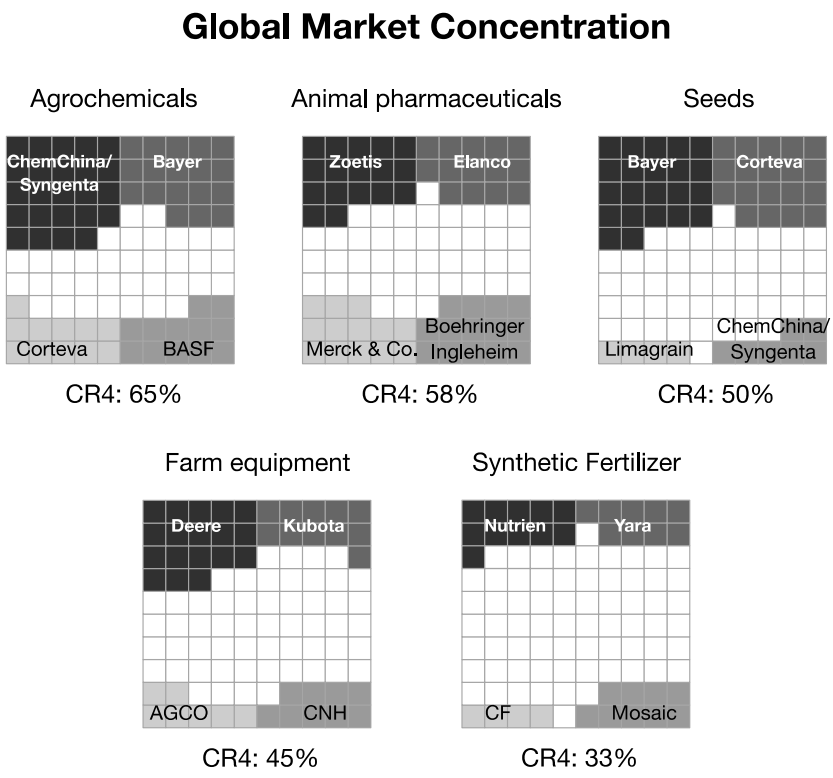

Figure 2: Global market concentration in selected agricultural inputs.

Farm Level and Producer Consolidation

The figure below indicates how consolidated agriculture has become at the farm level since the 1980s. The midpoint – where half of the farms have smaller numbers and half have larger numbers – has increased 50-fold for hog farms, and a median dairy farm is 16 times bigger in 2017 than in 1987. MacDonald et al. (2020) show that dairy has been consolidating at the farm level faster than any other sector in recent years, with the midpoint herd size increasing from 80 in 1987 to 1,300 in 2017. In crop farming, the share of acres in farms larger than 2,000 acres has more than doubled in 40 years, from 15% to 37%, while the midpoint for all crop farms stood at 1,445 acres in 2017, up from 650 acres in 1987 (MacDonald 2020). MacDonald further notes (p. 6), "Almost all of that expansion came at the expense of farms with 100–999 acres, whose share fell from 57% of cropland acres to 34% over thirty years. The net effect was that 85–90 million acres of cropland shifted out of the midsize class and into the largest acreage class over 1987–2017."

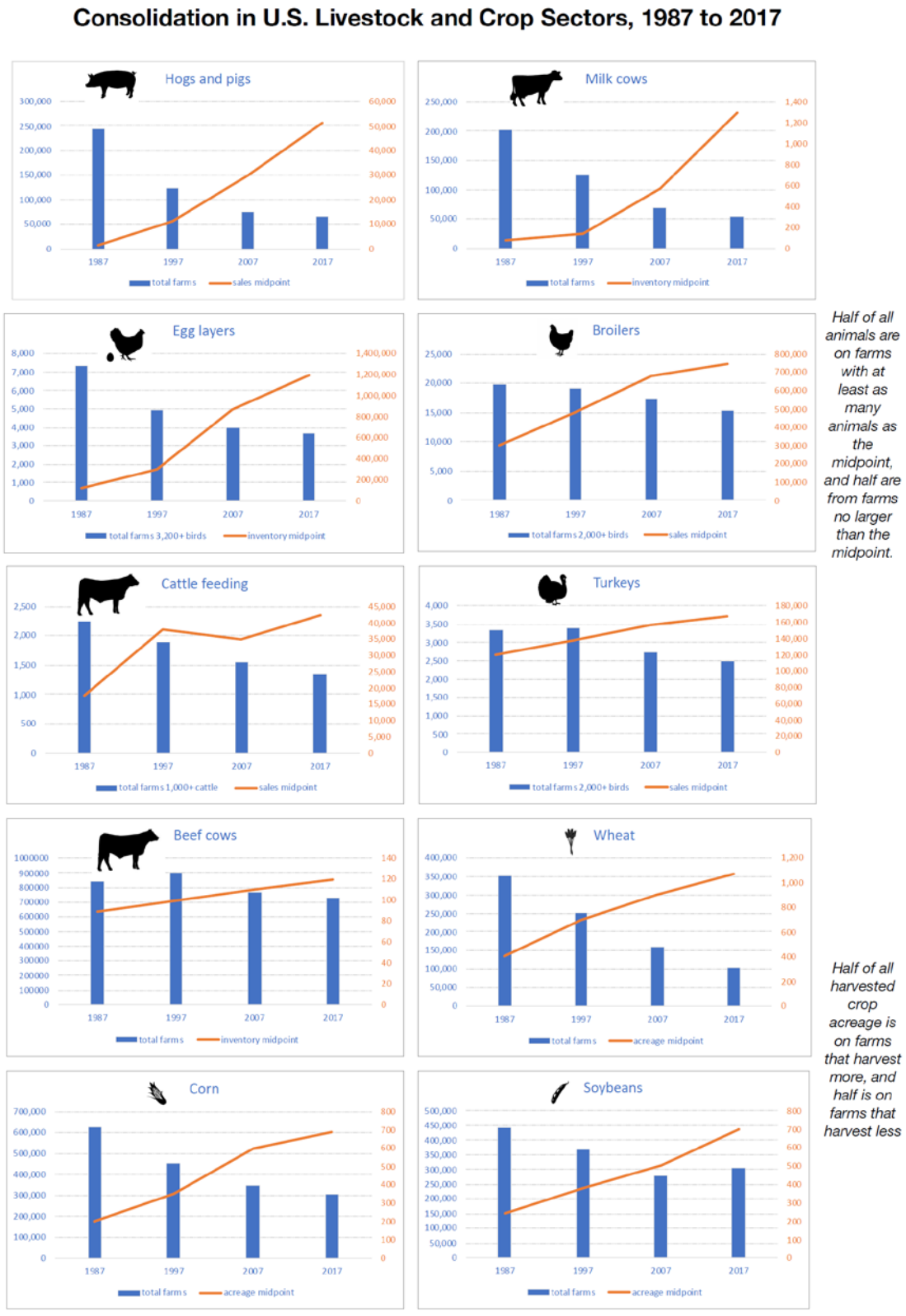

Figure 3: Number of farms and mid-points of farm sizes for selected agricultural commodities.

These figures do not fully represent the scale of the very largest farms, such as dairies with 30,000 or more cows, and feed yards with 100,000 or more cattle. The top four cattle feeders have a total capacity of over 2.5 million head, as estimated from multiple sources, about 500,000 more than they had in *Cattle Buyer's Weekly* estimate in 2015.[5] In addition, the four largest pork producers have between them nearly 1.8 million sows in the U.S..

Table 1: Largest U.S. Cattle on Feed Producers	**One-time Capacity**	**Supplier to**
Five Rivers (Pinnacle Asset Management)	980,000	JBS[6]
Cactus Feeders	600,000[7]	N/A, possibly Tyson
Friona Industries	577,000[8]	Cargill[9] and others
Green Plains	355,000	Cargill[10]
None of the 3 largest packers feed their own cattle outright after the sale of Fiver Rivers sale in 2018. Note that feedlots likely turn capacity twice per year, so 600,000 one-time capacity equates to about 1.2 million head per year. In 2015, Cattle Buyers Weekly pegged the 4 largest feeders as JBS Five Rivers, Cactus Feeders, Cargill and Friona, with a total capacity of 2.06 million.		

Table 2: Largest U.S. Pork Producers	**# Sows 2019**	**# Sows 2018**	**# Sows 2010**
Smithfield Foods (WH Group)	930,000	950,000	876,804
Seaboard Farms	345,000	340,000	213,600
Pipestone System	282,000	251,000	140,000
Iowa Select Farms	242,500	235,000	157,500
Source: Successful Farming Pork Powerhouses 2019 and 2010.			

Processing and Trading

The largest firms may pick up and discard divisions like a game of trading cards, with a goal of becoming more dominant in specific markets. The figure below indicates the names of processing firms and their market shares for a number of key products. Some industries that were already highly concentrated decades ago, such as beef processing, have experienced ownership changes. This has resulted in two firms headquartered in Brazil – JBS and Marfrig – taking the first and fourth place in market share, respectively. Cargill remains in third place for beef and soybean processing, but sold its pork division to JBS in 2015 – due to its inability to move up from a fourth place position in this segment, according to some analysts.[11] Similarly, Tyson sold its chicken divisions in Brazil and Mexico to JBS in 2014, rather than trying to compete in markets where JBS had strong government support. These changes contributed to JBS

[5] https://r-calfusa.com/wp-content/uploads/2013/04/160125-Top-30-Cattle-Feeders.pdf
[6] https://www.agprofessional.com/article/sale-worlds-largest-cattle-feeder-jbs-five-rivers-finalized
[7] https://tscra.org/care-for-the-cattle-comes-first-at-cactus-feeders/
[8] https://www.drovers.com/article/friona-ind-buys-two-cattle-empire-feedyards
[9] https://www.cargill.com/news/releases/2016/NA31962055.jsp
[10] https://www.drovers.com/article/cargill-exits-cattle-feeding-sells-two-yards
[11] https://www.nationalhogfarmer.com/marketing/cargill-jbs-deal-changes-pork-industry-landscape

overtaking Tyson to become the world's largest meat processor. Smithfield was once the largest processor in the pork segment, for both the U.S. and the world, until it was acquired by the WH Group in 2013 with backing from the government of China.

Beer is a rare industry that is experiencing decreasing concentration in the U.S., in part due to growing competition from craft breweries. The leading firm, Anheuser-Busch InBev (Belgium), has responded by acquiring 17 formerly independent craft breweries since 2011, although these ties are not indicated on the product labels (Howard 2018). The bread industry is consolidating quite rapidly via acquisitions, however, and the leading firm, Grupo Bimbo, is headquartered in Mexico.

Grain trading has long been dominated by just a few firms – ADM, Bunge, Cargill and Louis Dreyfus – but in recent years, the Chinese firm, COFCO, has joined their ranks. COFCO is China's largest state-owned agrifood company (Belesky and Lawrence 2019). It has become the second largest global grain trader in just a few years, after acquiring firms in the Netherlands and Hong Kong, and surpassing Dreyfus, Bunge and ADM.

Retail and Distribution

The supermarket industry rapidly consolidated beginning in the late 1990s. These trends for convenience stores and food distributors have accelerated more recently. The top firms have been very active in making acquisitions, such as 7-Eleven's purchase of 3,900 stores from Speedway in 2020 and Sysco acquiring half a dozen other distributors in 2019. Some newer forays from retailers include backward integration up the supply chain, particularly in dairy and meat processing.[12] Kroger, which has long been vertically integrated, may produce up to 90% of fresh milk for its stores, and even sells some of its supply to a competitor, Food Lion.[13] While food retailers have long sold private-label grocery brands, these moves may represent something different. Walmart has moved into integrating dairy and beef processing, developing its own supply chain for Angus beef, which includes partnering with Creekstone Farms in Kansas for slaughter and FPL Foods in Georgia for packing.[14] Costco, the third largest food retailer, set up their own poultry production and processing operation in

Common Ownership Across Products and Market Channels

Asset management firms are increasing their shares in multiple firms in the same sector, and this "common ownership" or "horizontal shareholding," in markets that are already highly concentrated, may further reduce incentives to compete (Clapp 2019, Clapp & Purugganan 2020). BlackRock and Vanguard, for example, both own significant shares in at least five dominant firms in both meat and dairy processing, as well as all three leading soft drink firms, and all three leading cold cereal firms.

[12] Howard (2016) documents that Kroger controlled 20 % or more of the milk supply in the St. Louis area by 1968.
[13] https://www.ey.com/en_us/consumer-products-retail/how-vertical-integration-is-impacting-food-and-agribusiness and two *Wall Street Journal* articles https://www.wsj.com/articles/walmart-kroger-bottle-their-own-milk-and-shake-up-american-dairy-industry-11595872190 and https://www.wsj.com/articles/retailers-are-bottling-their-own-milk-raising-pressure-on-dairy-companies-1507887002
[14] https://www.wsj.com/articles/walmart-to-develop-its-own-supply-chain-for-angus-beef-11556121364

Nebraska.[15] By doing so, the company may save 25 cents per rotisserie chicken, but it also gives them greater control over their supply chain to reduce uncertainty.[16]

[15]https://www.npr.org/2018/10/22/659561091/costco-builds-nebraska-supply-chain-for-its-5-rotisserie-chickens and https://civileats.com/2018/12/11/costcos-100-million-chickens-will-change-the-future-of-nebraska-farming/

[16] https://www.ey.com/en_us/consumer-products-retail/how-vertical-integration-is-impacting-food-and-agribusiness

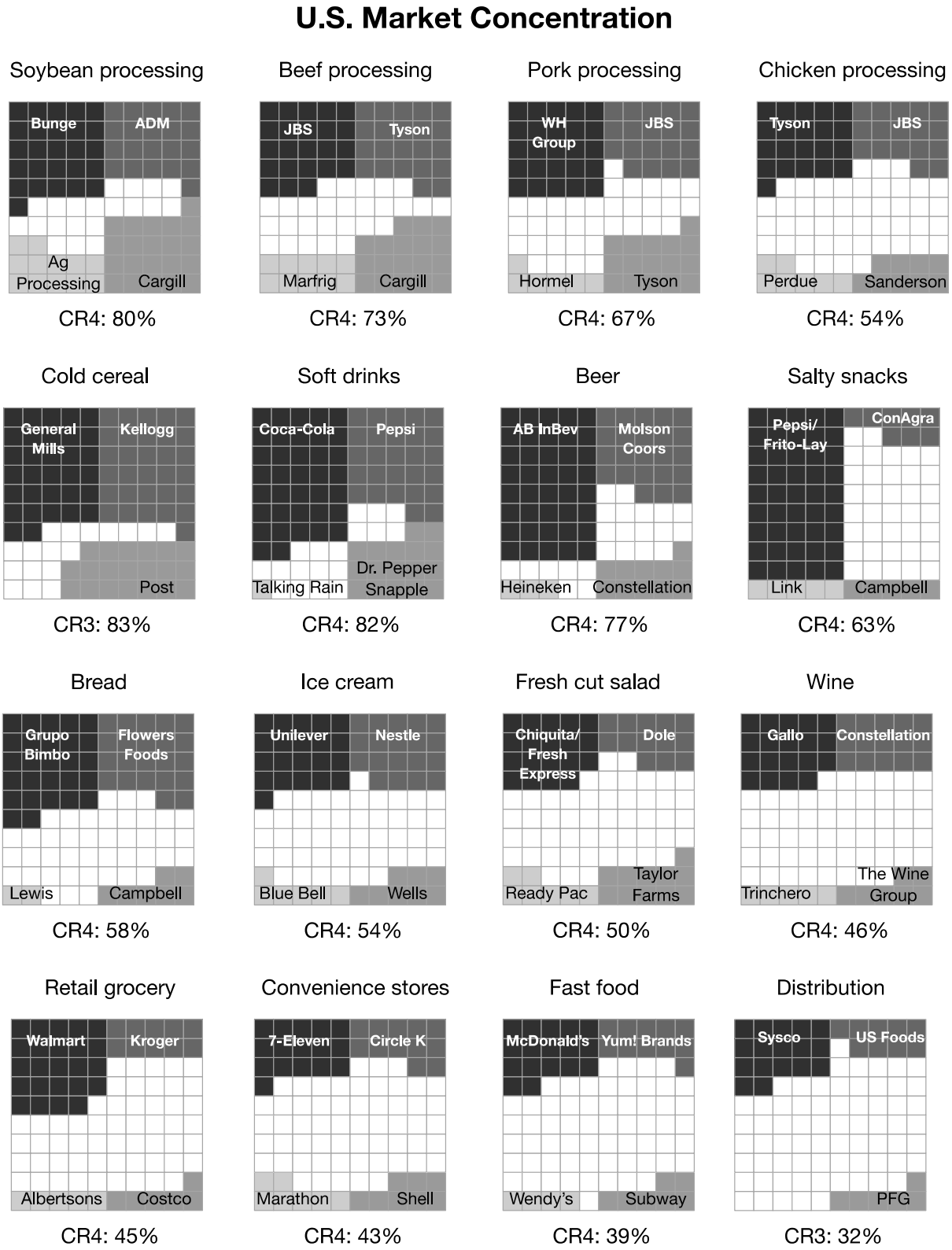

Figure 4: Concentration ratios for selected commodities, food processing/manufacturing, and distribution/retail channels.

Impacts on Farmers, Workers, Communities and the Environment

The concentration and consolidation we have broadly outlined has often been justified on the basis of efficiency, despite failing to incorporate an enormous number of social, economic and ecological externalities when calculating such measures. Nearly 50 years ago, in a series entitled "Who Will Control Agriculture?," agricultural economists Briemyer, Guither and Sundquist (1973) warned that the changing organization of agriculture did not enhance the efficiency or productivity of the system and would exact social and psychological costs on farmers and society. In addition, some recent studies have failed to measure efficiency gains (nor price reductions) from consolidation in manufacturing (Blonigen and Pierce 2016). Defenders of the current monopolized system cite that consumer welfare has not been harmed,[17] yet consumer prices are "sticky," rising when costs for powerful processors and retailers increase, but less likely to fall when prices paid to farmers decrease (Shields 2010). Recently, a number of lawsuits point to multiple cases of price-fixing, including in tuna, and allegedly in chicken, beef and pork.[18] For those of us concerned with resilience, efficiency has often been the enemy of redundancy, which can provide fail-safe mechanisms, making systems more resilient. Here we present two cases – the meat industry and the widespread problems with the herbicide dicamba – to illustrate the fragility and interconnectedness of the dominant agrifood system.

The Meat Industry

Nowhere is this systemic vulnerability clearer than in the protein sector, which has been hard hit by the COVID-19 crisis, particularly in North America. Meat production, processing and consumption have risen steadily in recent years, part of the "meatification" of global society (Weis 2015; Winders and Ransom 2019). Increased meat consumption is a central component of the industrial diet developed in the United States (Winson 2013) and diffused globally, contributing to obesity epidemics throughout the world (Otero 2018). The feed/meat complex has developed with concerted cooperation between state and market actors through various subsidies and pro-business regulations (Howard 2019). Meatification, primarily the feed/cattle complex, is also a major contributor to greenhouse gas emissions (IPCC 2018). Meat processing is one of the most dangerous jobs in the United States, especially hazardous for immigrant groups with limited English-speaking skills and sometimes precarious legal status (GAO 2005; Choi and Constance 2019; Human Rights Watch 2005). The "chickenization" of the red meat industry has restructured meatpacking from a dangerous, but good paying, blue-collar, union job dominated by white males to an even more precarious working-class, non-union job, often staffed by marginalized female, immigrant, and refugee groups (Freshour 2019; Schwartzmann

[17] Dorsey et al (2020 p. 862) are perhaps the latest to argue that "the elegant 'consumer welfare standard'… offers a rigorous, objective, and evidence-based framework for antitrust analysis."

[18] See summary of alleged price-fixing of pork at https://thefern.org/ag_insider/more-antitrust-lawsuits-hit-the-meat-industry-this-time-its-pork/, chicken at https://www.porkbusiness.com/article/three-poultry-execs-plead-not-guilty-price-fixing, and beef at https://www.agriculture.com/livestock/cattle/lawsuits-allege-price-fixing-by-big-beef-companies. The most recent case is a lawsuit by restaurant chain Bob Evans alleging price-fixing in poultry: https://www.meatingplace.com/Industry/News/Details/94274.

2013; Stull 2019; Stull and Broadway 2005). Finally, "chickenization" is also restructuring the protein production sector away from open markets to contract farming, as captive supplies in beef (see Table 1) and contracting in pork further marginalize producers.

This protein sector clearly illustrates the complex interconnectedness of one industry. Recently, this sector revealed how worker vulnerabilities triggered by COVID-19 created crises in worker welfare, animal welfare and farmer livelihoods during the pandemic. In our consolidated farm and food system, farmers, workers and the environment are interconnected, meaning that when problems hit one part, they quickly engulf others. For meatpacking, the coronavirus hit workers, and a supply chain focused on efficiency quickly broke down. Below we focus on the impacts to workers, farmers and the environment of this one massive disruption that is a wake-up call to redesign the system.

Labor: According to reporting by Leah Douglas at the Food and Environment Reporting Network, over 40,500 workers in 417 meatpacking plants had tested positive for COVID-19 by mid-August, and 189 meatpacking have died from it (see Figure 5). Transmission of COVID-19 among workers has been rapid and difficult to control in almost all large-scale poultry, pork and beef processing plants in N. America, Europe and Latin America. For instance, the Centers for Disease Control (CDC) reported that in 14 states, 9% of meat and poultry processing workers were diagnosed with COVID-19 by the end of May. Close working conditions for long time periods, shared transportation to work, and shared (congregate) housing were highlighted by the CDC as potential causes. When industry CEOs such as Don Tyson warned of a meat supply crisis due to plant shutdowns, President Trump issued an executive order that declared meatpacking plants to be "critical infrastructure" under the Defense Production Act and prohibited their closure by state health authorities.[19]

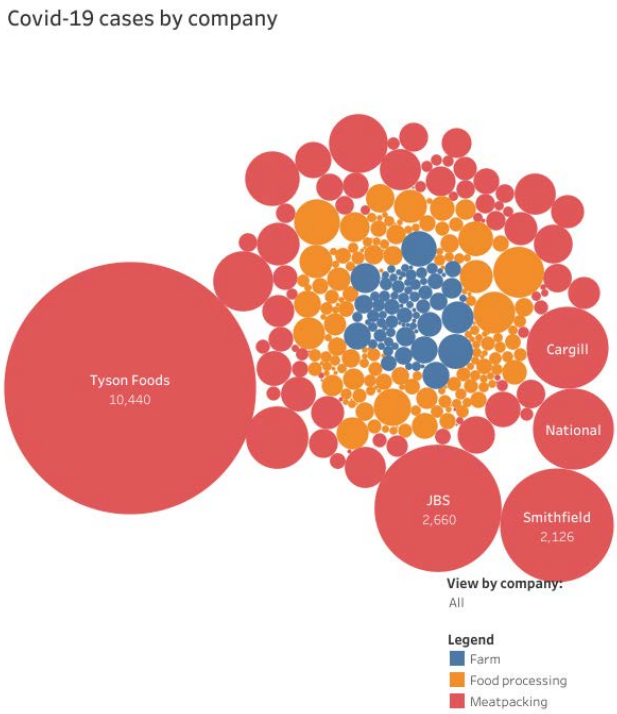

Figure 5: Counts as of August 12, 2020 by Leah Douglas, Food and Environment Reporting Network Accessed at: https://thefern.org/2020/04/mapping-covid-19-in-meat-and-food-processing-plants/

Farmers/Animal Welfare: By mid-April, nearly 20 percent of daily pork processing capacity had been idled by COVID-19, with similar problems in beef processing.[20] An early outbreak at a Smithfield Foods plant in S. Dakota shut down a plant responsible for 5 percent of the nation's daily pork slaughter.[21] When a plant that processes nearly 20,000 animals a day closes, it creates

[19] https://www.theatlantic.com/ideas/archive/2020/05/essentials-meatpeacking-coronavirus/611437/
[20] https://www.dtnpf.com/agriculture/web/ag/news/article/2020/04/20/plants-suspend-operations-growing
[21] https://www.meatingplace.com/Industry/News/Details/91490

crises for farmers supplying that plant. They must either feed those animals, find an alternative market or euthanize them. Alternative markets for 20,000 pigs per day are difficult to find, even outside a pandemic situation. One agriculture press article estimated that nearly a million pigs had disappeared from slaughter markets in the second quarter of the year, with anywhere from 300,000 to 800,000 pigs euthanized.[22] At the low estimate, that's nearly 29,000 tons of pork destroyed.[23] At least 2 million chickens were also euthanized by mid-May.[24] Previous mass euthanizations occurred in the wake of livestock disease epidemics, such as porcine diarrhea virus epidemic in 2013 and avian influenza in 2015. The genetic uniformity of these animals contributed to their susceptibility—globally just one breed accounts more than 99% of turkeys, for example, and in the U.S. more than 85% of dairy cows belong to the Holstein breed. Mass euthanasia of healthy, marketable livestock has undoubtably caused emotional trauma for farmers, and all of us can lament the tremendous loss of life and natural resources embodied in the once living animals. The wastefulness of a system with few fail-safe mechanisms is astounding. It also clearly illustrates that our agrifood system more heavily emphasizes relations of power rather than feeding people.

Food, Feed and the Environment: Meat production at this scale requires enormous amounts of corn and soybeans, two of the seven so-called "program crops" that have historically been heavily subsidized by the U.S. Farm Bill, both through direct payments and subsidized crop insurance (Starmer and Wise 2007; see also Congressional Research Service 2018).[25] Howard (2019) argues that firms like Tyson, Smithfield and JBS were able to consolidate due to low feed costs, made possible by direct and disaster payments that kept row-crop farmers producing even though market prices did not cover their costs. Most of the best soil in the U.S. is devoted to the production of corn and soybeans.[26] In 2018-2019, just under 40% of the U.S. corn crop was used for feed[27] - some of which those hogs and chickens ate before they were euthanized. [28] The corn-soy rotation that covers much of Corn Belt, contributed to the Heartland region having the lowest diversity in seven of the eight USDA census years between 1978 and 2012 (Aguilar et al. 2015).[29] Monocultures negatively impact the provision of ecosystem services and biodiversity through simplifying the ecosystem and by requiring higher production inputs (Klasen et al. 2016). Corn and soybeans become the de facto crop rotation across large portions of the Corn Belt, with associated soil erosion that was estimated to cost Iowa farmers $1 billion per year (Eller 2014). Soil erosion costs the entire U.S. over $44 billion per year, including $100 million

[22] https://www.agri-pulse.com/articles/14018-number-of-hogs-euthanized-due-to-covid-19-impacts-still-unknown
[23] We calculated 300,000 hogs at market weight of 275 pounds, dressing out at a minimum of 70%.
[24] https://www.theguardian.com/environment/2020/may/19/millions-of-us-farm-animals-to-be-culled-by-suffocation-drowning-and-shooting-coronavirus
[25] "From 2007 to 2016, the total net cost of the federal crop insurance program was about $72 billion" of which 60% went direction to producers and 39% went to private insurers (Congressional Research Service 2018)
[26] https://www.ers.usda.gov/topics/crops/corn-and-other-feedgrains/feedgrains-sector-at-a-glance/
[27] https://www.fapri.missouri.edu/wp-content/uploads/2020/06/2020-June-Update.pdf
[28] If 300,000 market-weight pigs (275 pounds each) were euthanized, using feed rations from Iowa State Hog Market Ag Decision Maker, that would represent 3.4 million bushels of corn fed, or about .024% of 2018-19 US corn production, using FAPRI figures.
[29] The Heartland region as defined by USDA encompasses all of the states of Ohio, Indiana, Illinois and Iowa, most of Missouri, and portions of eastern Nebraska and South Dakota, southern Minnesota, and southwestern Kentucky (Aguilar et al. 2015).

in lost farm income.[30] The washing away of nitrogen and phosphurus fertilizers in top soil contributes to hypoxia, such as the Dead Zone in the Gulf of Mexico.[31] A renewed interest in soil health has led to increased use of cover crops and reduced tillage which can alleviate these problems, but still fewer farmers on the land farming larger acreages make the labor and timing of such practices challenging (Hendrickson 2019). Few if any markets exist for diversified crops and livestock meaning crop rotations are limited (Roesch-McNally et al. 2018).

Dicamba Debacle:"[T]he herbicide for which [Mike] Wallace literally gave his life"[32]

Dicamba, registered as an herbicide in 1967 and available in 1,000 products in the U.S.,[33] has recently pitted farmer against farmer and farmer against community, as well as given "all of agriculture a black eye"[34] in the words of one weed scientist. In the five years since Monsanto's (now Bayer's) Xtend dicamba resistant soybeans were approved, all of the large agrochemical-seed firms have introduced dicamba-tolerant seeds, including ChemChina, Corteva, BASF and Bayer.[35] In the same time period, the Heartland has witnessed one related murder,[36] thousands of dollars of uncompensated off-target injuries and failure of institutions to combat the power of agriculture firms.

Power Play: In 2015, Monsanto's Xtend (dicamba-glyphosate tolerant) soybeans were approved for the 2016 planting season, even though the accompanying less volatile formulation of dicamba was not approved.[37] Thus the dicamba formulation available in 2016 was not allowed for "in-crop" use as it was volatile and could easily drift. Monsanto continued to sell these beans, and seemed to blame farmers when some "tried using older formulations of dicamba and the off target movement was very bad."[38] Indeed, court documents in a peach grower's lawsuit against Bayer and BASF suggest that the companies "created circumstances that damaged millions of

[30] The $44 billion per year includes lost productivity, along with sedimentation and eutrophication of water reservoirs according https://www.farmprogress.com/soil-health/high-cost-soil-erosion. Sartori et al. (2019) estimated the global costs of soil erosion due to water at $8 billion annually, reducing global food production by 33.7 million tonnes and raising prices by up to 3.5%.

[31] In 2017, the Dead Zone, an area of low or no oxygen that kills aquatic life, was 8,776 square miles. Measurements in 2020 were disrupted by Hurricane Hanna. https://www.noaa.gov/media-release/smaller-than-expected-gulf-of-mexico-dead-zone-measured

[32] https://arktimes.com/news/cover-stories/2017/08/10/farmer-vs-farmer

[33] https://usrtk.org/pesticides/dicamba/

[34] Bill Johnson, Purdue University, weed scientist: https://www.dtnpf.com/agriculture/web/ag/crops/article/2018/07/20/dicamba-moves-beyond-bean-fields-eye

[35] For a complete list of brand names see https://www.agriculture.com/crops/soybeans/whats-next-for-dicamba-tolerant-technology.

[36] Missouri farmhand Allan Curtis Jones was convicted of shooting Arkansas farmer Mike Wallace seven times and killing him in an apparent dispute over the spraying of dicamba by Jones and resulting damage to Wallace's fields. https://www.agweb.com/article/man-convicted-of-murder-in-feud-with-farmer-over-dicamba-apnews

[37] "Roundup Ready 2 Xtend soybeans are tolerant to both glyphosate and dicamba. It allows for the use of dicamba herbicide over the top of Roundup Ready 2 Xtend soybeans to help control problem weeds." https://www.farmprogress.com/story-asgrow-roundup-ready-2-xtend-soyeans-arrive-missouri-9-139092 For a history see https://www.reuters.com/article/us-monsanto-dicamba-specialreport/special-report-the-decisions-behind-monsantos-weed-killer-crisis-idUSKBN1D91PZ.

[38] https://ipm.missouri.edu/MPG/2017/11/dicamba/

acres of crops by dicamba in order to increase profits from a set of new dicamba-related products offered for sale beginning in 2015."[39]

By 2017, the new formulations of dicamba had been approved so farmers could plant dicamba-tolerant soybeans and legally use dicamba to control weeds in mid-summer. Still dicamba damage continued. There were reports of so-called defensive planting, whereby farmers protected themselves from neighboring farmers' use of dicamba by planting Xtend or other dicamba tolerant soybeans[40] – especially if the price was not substantially different than other traited seeds.[41]

While dicamba resistant soybeans were widely planted from 2017-2020, – largely because of resistant weeds like waterhemp and Palmer amaranth, problems with dicamba use remained. Weed scientists at the University of Missouri detailed potential problems with volatility even with new formulations.[42] In February, 2020 a jury awarded Bader Farms, a peach orchard, $15 million in compensation for damages from off-target dicamba drift, and awarded over $200 million more in punitive damages.[43] In June, the agriculture community was stunned when a federal court ruled that EPA's approval of reformulated dicamba (XtendiMax, Engenia and FeXapan) in use on "an estimated 60 million acres of soybeans and cotton [was] vacated – or ended – effective immediately."[44] Farmers could apply any existing stocks of those herbicides through July 31, 2020.[45]

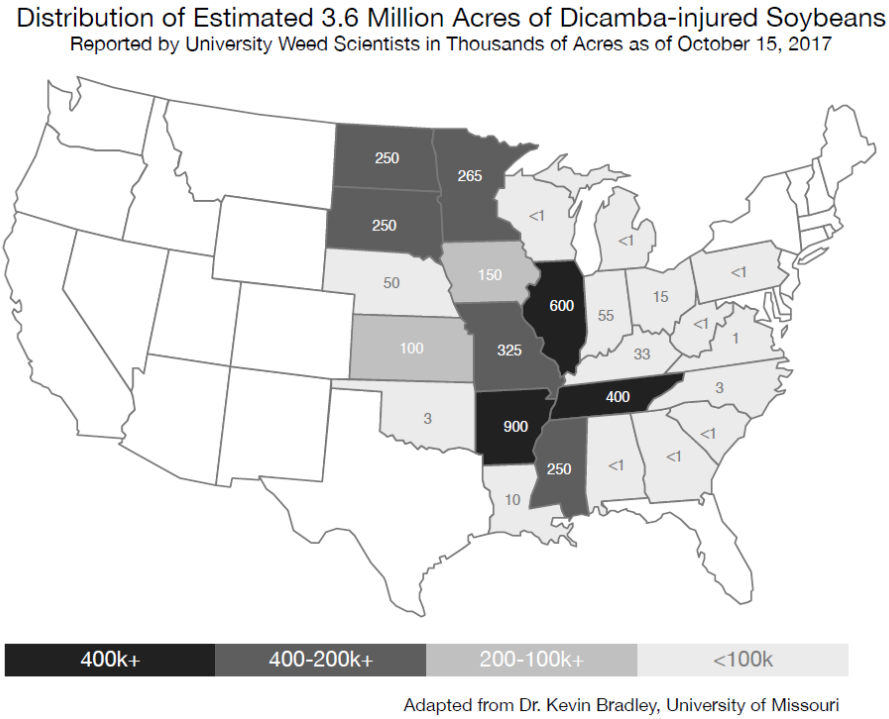

Figure 6: Distribution of dicamba-related soybean injuries known in 2017.

[39] https://www.agriculture.com/crops/pesticides/dicamba-on-trial

[40] "'I had to start growing dicamba beans because the losses were so much you can't stand it,' said Sam Branum, a recently retired farmer near Hornersville [MO]. 'If you're farming around it, you either get with it, or you get out.'" Another Missouri farmer Carlis McHugh said "We switched over to it to protect ourselves…You didn't have a hell of a lot of choice, if you know what I mean." https://www.rfdtv.com/story/41832450/dollar265m-dicamba-verdict-could-give-other-lawsuits-victories.

[41] Personal conversation with one author's relative, a farmer who chose to defensively plant dicamba tolerant soybeans.

[42] https://ipm.missouri.edu/IPCM/2019/4/dicamba/

[43] https://www.agriculture.com/news/business/bader-farms-wins-dicamba-lawsuit-against-bayer-basf

[44] https://www.dtnpf.com/agriculture/web/ag/crops/article/2020/06/04/know-legal-status-dicamba

[45] https://agriculture.mo.gov/news/newsitem/uuid/dd3b5f4d-abd2-4466-937e-325d51fd29f2/missouri-department-of-agriculture-follows-epa-guidance-on-dicamba

Environmental Consequences of Corporate Actions: To understand the problems with dicamba, Howard and Hubbard (2020) trace changes in the seed industry, with historic seed firms first being acquired in the 1970s by oil and grain trading companies, and then by agrochemical companies in the 1990s. The latter was spurred by slowing rates of growth in agrochemical sales largely due to environmental concerns. Then came herbicide-tolerant crops, starting with the introduction of Monsanto's Round-Up Ready soybeans in 1996. Agrochemical-seed firms could now bundle seeds and chemicals, which could keep farmers dependent upon one firm for these inputs (James, Hendrickson and Howard, 2013).

The herbicide dicamba has been in use since the 1960s, primarily in corn production, but tensions exploded in 2016. Why? Monocropping in cotton, corn, and soybeans have created a plethora of herbicide-resistant weeds[46] that have occurred since the introduction of Round-Up Ready seeds. Dicamba-tolerant, as well as 2,4-D tolerant seeds, were seen as an urgently needed solution. As Missouri weed scientist Kevin Bradley notes, dicamba became a problem for two reasons: farmers spray more to combat weeds such as herbicide resistant pigweed (*Amaranthus palmeri*), which we note thrives particularly well in a rapidly changing climate; and dicamba is being used later in the season, which makes it vulnerable to drift due to hot and humid conditions.[47]

This overreliance on one single weed management tool – herbicides – alarmed soil scientists who argue that soil conservation gains are threatened by the tillage desperate farmers use to control weeds, and called for an "integrated weed management" approach (CAST 2012).

Community Impact: The volatility of dicamba has pitted neighbor against neighbor in rural communities. The most poignant, of course, is the murder of Mike Wallace by his farming neighbor's employee, Curtis Jones, over dicamba drift damage to an estimated 40% of Wallace's crops. In the months after this murder, Wallace's family worked to get a permanent ban on dicamba, "a quest that has put Wallace's family at odds with many of their neighbors."[48] Others acknowledge the potential community problems, as this Arkansas farmer said in 2017, "We're trespassing on our neighbors, and we're trespassing on our neighbors in town. It's not just our neighbor farmers. There's a lot of damage in yards. You hate to say that and call attention to it, but it is a reality."[49]

In 2018, just two years after dicamba tolerant beans were introduced, an investigation by the agricultural news service DTNPF on community impacts of dicamba drift exposed the destruction of a South Dakota CSA farm's crops, a Tennessee rural resort struggling to save gardens and trees, and an Illinois homeowner who spent at least $10,000 investigating damage from dicamba on her "carefully landscaped yard."[50] In all these cases, individuals – in the first two instances, consumers and farmers attempting to build agrifood alternatives – were blind-sided by the constrained choices of conventional farmers (e.g. Hendrickson and James 2005). In essence, the rights of rural community members to make choices about their livelihoods or even

[46] There are 514 unique cases of herbicide resistant weeds globally, involving 262 species, in 93 crops in 70 countries: http://www.weedscience.org/Home.aspx

[47] https://www.harvestpublicmedia.org/post/dicamba-has-been-around-years-why-would-it-now-be-causing-problems and https://ipm.missouri.edu/MPG/2017/11/dicamba/

[48] https://arktimes.com/news/cover-stories/2017/08/10/farmer-vs-farmer

[49] https://arktimes.com/news/cover-stories/2017/08/10/farmer-vs-farmer

[50] https://www.dtnpf.com/agriculture/web/ag/crops/article/2018/07/20/dicamba-moves-beyond-bean-fields-eye

their enjoyment of rural properties is usurped by the right of dominant agrifood companies to profit or of conventional row-crop farmers to control weeds.[51] Perhaps the situation is best summed up by a Missouri farmer interviewed in 2019 (James et al. 2020): "With Dicamba, you can do everything right and it can still move around and damage the neighbor's orchard or the garden of the lady down the road….morally, can you spray a product that you have no control over once it leaves the boom tip and you have to rely on Mother Nature to keep it where it's at and you damage someone else's crop?"

Failure of Institutions: The power of these dominant firms is also demonstrated by the failure of the EPA and state agencies to regulate dicamba, and the struggle by universities to provide accurate information about its use. University weed scientists were caught off-guard as dicamba related injuries accumulated in 2016 and 2017.[52] Some state agencies have been in the cross-hairs between corporate power, desperate farmers and community concerns. For instance, after the Arkansas Plant Board restricted use of dicamba-based herbicides in 2016 and 2017, Monsanto sued the board "arguing that the 2016 rule had effectively prohibited in-crop use of XtendiMax in 2017, and that the 2017 rule would effectively prohibit in-crop use of XtendiMax in 2018." At the same time, farmers also sued the board after it set an early April, 2018 cut-off date for spraying dicamba instead of the May 25 date.[53]

Other state agencies responsible for regulating herbicides issued and rescinded bans limiting use at certain times,[54] and pleaded with EPA to ban post-emergent use when reregistering the chemical.[55] States were flooded with damage reports,[56] even though some farmers felt state agencies were reluctant to investigate and even discouraged reports.[57] The federal judiciary stepped in, vacating EPA's approval of three specially formulated herbicides in the middle of the 2020 growing season.[58]

Farmer and Community Impacts

Both of these cases serve as illustrations for the impacts of concentration in the food system across multiple, global scales. As Hendrickson (2015) argues, a consolidated system constrains the ability of farmers to manage their farms using agroecology, which requires diversity and redundancy, rather than specialization and efficiency. In *Too Big to Feed*, the International Panel of Experts on Sustainable Food Systems (IPES-Food 2017)[59] argued that agrifood consolidation

[51] Ashwood et al (2019) show how Right-to-Farm laws prioritize the right to profit from property over other rights such as the right to sustenance or the right to heritage. In addition, Ashwood (2018) explores how government enforcement of the right to profit has undermined democracy in rural communities.
[52] Kevin Bradley writing a plea to understand dicamba, and also linking other weed scientist articles: https://ipm.missouri.edu/IPCM/2017/7/Ag_Industry_Do_we_have_a_problem_yet/
[53] https://nationalaglawcenter.org/the-deal-with-dicamba-part-one/
[54] See a summary at https://www.dtnpf.com/agriculture/web/ag/news/article/2019/03/01/illinois-arkansas-others-add-state.
[55] https://www.dtnpf.com/agriculture/web/ag/news/article/2020/04/30/state-regulators-ask-epa-ban-dicamba
[56] See https://www.dtnpf.com/agriculture/web/ag/crops/article/2019/12/10/states-report-another-year-dicamba
[57] On-going research being conducted by Hendrickson and colleagues.
[58] https://www.dtnpf.com/agriculture/web/ag/crops/article/2020/06/04/know-legal-status-dicamba
[59] One of the authors, Philip Howard, is a member of this panel. The report is available at http://www.ipes-food.org/_img/upload/files/Concentration_FullReport.pdf.

reduces farmer autonomy and redistributes costs and benefits across the food chain, thereby squeezing farmer incomes. The table below illustrates this squeeze. One can see that the *median* net farm income for intermediate farms, those grossing less than $350,000 and for which one of the operators considers farming an occupation, was -$1,524 in 2018.

Table 3: Principal farm operator household finances, by ERS farm typology, 2018

Item	Residence Farms	Intermediate Farms	Commercial Farms	All Farms
Number of farms	1,069,497	742,931	166,940	1,979,368
		Income, median dollars per household		
Farm income	-2,610	-1,524	141,614	-1,735
Off-farm income	90,559	46,483	41,000	65,841
Earned Income	74,305	7,910	17,500	37,500
Unearned Income	14,000	25,310	5,000	20,404
Total household income	88,220	50,097	195,254	72,481

Source: USDA-ERS. Residence farms are those where the operator is retired or has another occupation. Intermediate farms have at least one operator who spends 50% or more of work time farming and have agricultural sales <$350,000. Commercial farms are the same except have agricultural sales >$350,000. https://www.ers.usda.gov/data-products/farm-household-income-and-characteristics/farm-household-income-and-characteristics/#Farm%20Household%20Characteristics

As we have described, the agrifood system is a set of power relationships with dominant agrifood firms leveraging their power over farmers, workers and communities in producing, manufacturing and retailing food. This can have particular impacts on farmers, workers and communities of color. Johnson Gaither (2016) outlines how heirs' property[60] can affect how Black property owners, as well as heirs of Native American fractionated allotments and Texas *colonias*, are able to engage with government agriculture and land programs. Due to unclear titles or multiple heirs, farmers of color may also face displacement through land partition or tax sales (Dyer and Bailey 2008). This puts them specifically at risk of losing their farms through land consolidation, particularly as cultural rights and/or the right to sustenance are mostly superseded by the right to profit in current application of property rights (Ashwood, Diamond and Walker 2019). Farmers of color have also been historically locked out of conventional agricultural markets, leading them to forge alternative market arrangements – like cooperatives[61] – that can be vulnerable to dominant trading or supermarket firms.

[60] Gaither defines it as, "inherited land or real estate owned by two or more people as tenants in common" usually arising from a lack of a will or outside a formal probabe process. Gaither summarizes legal scholarship that notes Native Americans, who were often compelled to lease their land to Whites, did not consider land as a commodity which constrained their ability to participate in White notions of free markets.

[61] See Federation of Southern Cooperatives https://www.federation.coop/ and also https://www.wealthworks.org/success-stories/new-mexico-cooperatives.

Farmers and consumers frequently have far fewer options in the market than it appears. Farmers Business Network,[62] for example, notes that "Seed companies routinely label the same seeds under multiple brands with dramatically different prices." Recalls have illustrated the hidden yet widespread practice of contract packing, with identical foods from a single processing plant sold under as many as forty different brands, including those that appear to be direct competitors (DeLind and Howard 2008).

The IPES-Food (2017, p. 77) also argued that agrifood consolidation was "narrowing the scope of innovation," controlling information through a focus on big data, allowing labor abuses and fraud, and hollowing out corporate commitments to sustainability. IPES expressed concerns about increased environmental and public health risk – which were prescient as the pandemic has shown. Other scholars such as Drake (2013, p. 1083) detailed how non-white "communities across the United States disproportionately bear the burden of pollution by big agriculture" through exposure to excessive pesticide use and location of large-scale animal operations, thereby linking consolidation in the agrifood systems with civil rights.

As was illustrated with the dicamba debacle and meat industry consolidation, there are important community level impacts of consolidation in agriculture and food. Dicamba has divided rural communities, while the labor strategies of big meat have exacerbated impacts of immigration on communities, particularly in the Midwest. In their meta-analysis on the relationship between agricultural structure and community well-being, Lobao and Stofferahn (2007) found detrimental effects of industrialized farming on communities were reported in 82% of 51 studies. These negative effects included greater income inequality or poverty; decreased retail trade and diversity of retail firms; population declines; and negative health effects of large livestock operations. Gibson and Gray (2019) show how a consolidated agriculture "without people" has depopulated Western Kansas with an accompanying collapse of social relationships. A recent New Yorker article provides the human face of these effects, examining the unhappy fate of dairy farmers across a very productive region of Wisconsin, due to the rapidly changing structure of their industry, which has seen the elimination of many smaller (less than 300 cows) herds.[63] Such changes have social and political ramifications as rural areas depopulate, challenging the ability of rural communities to provide essential services and invest in businesses and infrastructure (Peters 2019).[64]

Possibilities for Democratizing the Food System

Our aim in this report was to document current conditions of consolidation within the agrifood system and to frame the social and ecological consequences of such a system. We are concerned that the relationships of power currently exhibited within the agrifood system have significant negative impacts on farmer livelihoods and autonomy, particularly for less powerful members of

[62] https://use.farmersbusinessnetwork.com/seed-relabeling-report-2018/
[63] https://www.newyorker.com/magazine/2020/08/17/how-suffering-farmers-may-determine-trumps-fate
[64] According to Peters research, of the 70% of non-metro counties that lost population since 2010, most were concentrated in the Great Plains and Midwest – the Heartland region that provides corn and soy. Some scholars at Iowa State, including D. Peters, have tried to help Iowa communities manage these processes through "smart shrinkage." https://www.news.iastate.edu/news/2018/10/31/shrink-smart

society, especially those who are systemically discriminated against and exploited based on race, gender, queer identity, ethnicity, or nationality. Centralizing food system decisions about what is produced, where, how and by whom damages farmers' abilities to treat their farms as specific agroecosystems and constrains their choices by determining what they can produce for what markets. In response to continued consolidation in agrifood, rural communities in some agricultural areas have depopulated, collapsing social relationships, while in others, relationships, livelihoods and property have been damaged by the choices of some farmers caught in a treadmill of monocropping. Vulnerable workers have been sacrificed to injury and illness, and serious questions arise about the social and ecological resilience of such systems in the face of climate change and societal turmoil.

At the heart of this analysis is a focus on power – both economic and political. Ultimately American political democracy rests on economic democracy and vice versa (Wu 2018). Thus, our laser focus in scholarship, praxis and policy must be on democratizing the agrifood system through a multitude of strategies at local, state, regional and national scales.

What would democratizing the food system look like? We already see a plethora of emerging alternatives from Community Supported Agriculture farms that intimately share risks and rewards with consumers to farmer cooperatives, urban agriculture farms, garden-based education, commons-based land ownership, fair trade or building values-based value chains that serve local and regional food systems. All of these in some way are attempting to reshape relationships of power within the food system. Full spectrums of innovations must be encouraged without cooptation or blocking by those whose power may be relatively diminished. This will only be achieved with an accountable, and truly democratic government, which has yet to be fully realized.

What is missing is analysis and action on policy that can be immediately deployed to reshape power relationships in agriculture and food. It is not our intent – nor our expertise – to offer fully formed policy solutions here. Rather we believe that democratizing food and agriculture will take policy-makers, farmers, workers and communities working together to fashion alternatives and policies that can help to:

1) Curb and prevent monopolistic tendencies in agrifood systems within all sectors and at all scales through diverse policy instruments from contract to competition law, including all titles of the Farm Bill.
2) Shine a racial lens in scholarship on agrifood system power and consolidation that highlight the myriad ways that economic power has often been built within and upon other relationships of power, providing new insights into potential remedies.
3) Adopt a stance prioritizing resilience and redundancy in business arrangements as well as policies.
4) Rethink core assumptions such as efficiency and property rights in ways that acknowledge their social and ecological consequences.
5) Encourage the development of alternative production and consumption arrangements that root producers and consumers in place, offer producers and consumers more choices at

different scales, afford more opportunities for communities to develop self-reliance, and reduce society's dependence on dominant agrifood firms.

6) Rethink what kinds of crops, livestock and even sectors of the food system are subsidized, and how they are subsidized, in a transparent iterative process that allows citizens to truly weigh their benefits and consequences.

To transform our agrifood system from one that is monopolized and brittle to one that is democratic, equitable, ecological and resilient will take many solutions and experiments across all scales and sectors of food production and consumption. We hope that we have contributed to this process by providing a framework for seeing and understanding the social and economic organization of the agrifood system.

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