

# The Climate Reality for Independent Restaurants

*A Deep Dive into the  
Supply Chain and New  
Economic Realities*



JamesBeard  
Foundation

Global Food Institute

THE GEORGE WASHINGTON UNIVERSITY



# Contents

04

Who  
We Are

08

Executive  
Summary

11

Landscape of  
Independent  
Restaurants

16

Global Food  
Supply Chain

23

Effects of  
(Un)natural  
Disasters on the  
Food Supply

31

Bring It  
Back Home

35

Change or the  
Climate Will

42

Conclusion:  
Finding the  
Sweet Spot

48

Contributing  
Authors

49

References

# Foreword

Heat domes, ice storms, floods,  
droughts, hurricanes, fires.  
There is no longer such a thing  
as a 100-year climate episode.

Catastrophic is the new normal. A new normal that adds immense pressure on an already strained independent restaurant industry, affecting not only availability and costs of ingredients but also the volume of business—when it's too hot or too cold, diners stay home.

The independent restaurant industry feels the economic impact of climate change on their operations every day. They watch their profit margins become ever smaller when costs increase and numbers of covers decrease. They feel it as business owners, as employers, as community leaders, and as community members. They need support to survive as the vibrant, beloved businesses who weave the rich culture of neighborhoods across America.

The mission of the James Beard Foundation (JBF) is to create a more sustainable and equitable restaurant industry, which means creating the right pathways for resilience against all the challenges the industry faces, informed by research and industry insights. We aim to rigorously identify climate-specific issues and make a data-driven case for meaningful change that allows the independent restaurant industry to not only survive but thrive in the face of climate adversity.

JBF has thus engaged George Washington University and the Global Food Institute for this research project around the economic impact of climate change for independent restaurants, with a particular focus on supply chains. It is our hope that this report not only informs our ongoing work, but serves as a catalyst for all other food system changemakers.

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**Dr. Anne McBride**  
Vice President, Programs  
James Beard Foundation

# *About the James Beard Foundation*

The James Beard Foundation (JBF) is a 501(c)3 nonprofit organization that celebrates and supports the people behind America's food culture, while pushing for new standards in the restaurant industry to create a future where all have the opportunity to thrive. Established over 30 years ago, the Foundation has highlighted the centrality of food culture in our daily lives and is committed to supporting a resilient and flourishing industry that honors its diverse communities. By amplifying new voices,

celebrating those leading the way, and supporting those on the path to do so, the Foundation is working to create a more equitable and sustainable future—what we call Good Food for Good®. JBF brings its mission to life through the annual Awards, industry and community-focused programs, advocacy, partnerships, and events across the country. Learn more at [jamesbeard.org](https://jamesbeard.org), [sign up](#) for our Industry Support newsletter, and follow @beardfoundation on social media.

# Who We Are

Global Food Institute

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THE GEORGE WASHINGTON UNIVERSITY

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Founded by José Andrés at the George Washington University, the Global Food Institute (GFI) will transform people's lives and the health of our planet by changing the way we view food's integral role in creating a greater world.

GW's unique location and strengths—excelling at the intersection of education, business, technology, healthcare, and international affairs—create the ideal environment for private- and public-sector global leaders to develop innovative solutions to our most pressing challenges.

Now is the time to use these advantages to solve the complicated problems of our time. Now is the time for the Global Food Institute to change the world through the power of food.

## Educating the Next Generation Through the Lens of Food

GFI will educate GW students with the knowledge and tools to approach their respective professional and academic pursuits through the lens of food. The next generation of alumni leaders will be prepared to offer unique perspectives to the food solutions of tomorrow.

## A Hub of Cross-Disciplinary Research and Innovation

Faculty from diverse fields will conduct interdisciplinary research that demonstrates the centrality of food in many of today's biggest challenges—hunger and poverty, public health, and the climate crisis, among others. The institute's findings will reinforce that food is actually part of the solution to these bigger challenges and will shape and inform domestic and global food policy.

## Convening Leading Experts in Global Food Policy

The institute will convene the world's leading experts across all disciplines to transform food systems and to improve people's lives and the health of our planet. Distinctive partnerships will invite new voices into critical conversations, breaking longstanding gridlock and amplifying overlooked voices.



As a chef, and in my work with restaurants around the world, I see first-hand the impact of climate change on the ingredients we source, the dishes we prepare, and on the communities and people we serve.

While this research resonates deeply with me, the implications extend far beyond my own personal experiences in the kitchen, or even those of other chefs and independent restaurants. They touch us all—from the farmers and fishers who grow our food, to the guests enjoying our meals.

In founding the Global Food Institute at GW, our aim is to produce cutting-edge research that unravels the complexities of our global food crisis. But we don't stop there. We gather knowledge and then use it to spark innovation, policy changes, and meaningful conversations that will catalyze solutions for humanity.

To paraphrase Brillat-Savarin, the future of our planet will depend

on how we feed ourselves. This report underscores the magnitude of that challenge. But! It also points to solutions and hope. Adopting more sustainable farming practices, protecting our nation's farms and farm workers, and strengthening our local and regional food systems—this is how we build resilience, one plate of food at a time.

This research is more than just a collection of data and insights; it's a rallying cry for chefs, restaurateurs, food producers, policymakers, and all actors across the supply chain. And it is just a taste of what's to come from the Global Food Institute in our urgent journey to shape a better food system.

—James Beard Award Winner

**José Andrés**







# Executive Summary

Independent restaurants by their nature are highly vulnerable. They are smaller than restaurant chains and lack their large and robust food supply chain. Climate change and its impact on the frequency and severity of (un)natural disasters presents the most immediate threat to the food supply chain of independent restaurants, and the decreased availability and quality of commodity and specialty crops represent a longer-term challenge. As climate change progresses, with every 1°C increase in global temperature, extensive losses will occur in the production of wheat, rice, maize, and soybean, four key staple grains that account for  $\frac{2}{3}$  of the world's caloric intake. Low crop supply will cause inflation, raising U.S. food prices from 0.4% up to 3.3%. These will likely be passed on to consumers. As we describe, one of the potential advantages of independent restaurants is that they have access to local food supply chains that may be more agile and resilient than national or global supplies.

## Independent Restaurants

Independent restaurants are the fifth-largest employer in the U.S., employing 3% of the U.S. workforce and paying almost \$75 billion in wages. Restaurants boast a diverse employee base with the most minority managers of any industry. Additionally, 41% of all restaurants are minority-owned. Independent restaurants are highly vulnerable to failure. For example, 26% fail in their first year of operation, 19% fail in the second year, and 14% fail in the third year—a 59% failure rate over three years. These rates are higher than their chain-affiliated counterparts, which may reflect the advantages conferred by established brand recognition and the substantially greater resources that chains typically possess.

## The Food Supply Chain

The food supply chain in the U.S. is also threatened by a decrease in farms. Between 2012 and 2017, the total number of farms decreased from over 2.1 million farms to roughly 2 million total farms in 2017, attributable in part to consolidation. In 2022, that number continued to decrease, and threatens to fall below the two million mark in the coming years. Paradoxically, American cropland is expanding. However, expansion is not leading to an increase in food crops, specialty crops, or more specifically, vegetable production. Instead, the growth in cropland is predominantly geared towards other industries, most notably livestock. Farmers are intensifying their operations to accommodate more animals in smaller spaces, with the aim of achieving higher productivity and returns. As of 2017, the commercial value of livestock, poultry, and their products was more than four times larger than the combined commercial value of vegetables, melons, potatoes, sweet potatoes, fruits, tree nuts, and berries, and that gap is only widening.

The decrease in the number of farms, and the increase in cropland used for commodity crops rather than food crops, means that the availability of locally produced foods, which are often featured by independent restaurants, may become more limited. Strategies to sustain small farms and farmers will be essential to sustain local food production.

## Role of Imported Food

Although the U.S. sources the majority of its food domestically, there is a growing reliance on imported produce. Over the past two decades, imported agricultural and livestock products accounted for 17.4% of consumed food. Fifty-two percent were horticultural products such as fruits, vegetables, tree nuts, wine, spirits, essential oils, and nursery stocks,

15% was sugar and tropical products like coffee and cocoa, 13% was animal and meat products, nine percent were grains and feeds, eight percent were oilseed products, and the remaining three percent comprised other items. Vegetable imports grew from 20 to 38% between 2007 and 2021, and fruit imports grew from 50 to 60%.

## The Effects of Climate Change on the Food Supply

Climate change has already been associated with major disruptions of food production and supply. We choose to call these major disruptions “unnatural disasters” because they are driven by the increase in greenhouse gases generated by human activities. To call these events “natural disasters” ignores their true origin. They are a consequence of climate change, not a cause.

In the 2020 United Nations Office for Disaster Risk Reduction report, 4,212 “natural disasters” were recorded from 1980–1999. These increased in the next two decades to 7,348. Between 2000 and 2019 climate related disasters increased even further: 28% increase in droughts, 232% in extreme temperatures, 134% in flooding, 40% in storms, and 46% in wildfires. During the 20-year span 2000–2019, human deaths due to these disasters have doubled to one million when compared to the previous two decades. Although this increase is shocking, what is more disturbing are the trends of these disasters in the last 42 months (Jan 2020–Aug 2023). The global average annual record of storms has increased by 19%, floods by 23%, and wildfires by 29%. These unnatural disasters can cause disruptions in both the local, regional, and global food supply chains.

The agriculture sector is one of the most climate-vulnerable sectors. Climate change affects every level, from local to global food security. As the effects of climate change increase, the food and transportation systems that independent restaurants depend on are increasingly threatened. Extreme events will disrupt food availability, reduce access to food, and impair food quality. For example, floods decrease crop yields, ruin equipment, contaminate the crops and soil, and

erode the soil. Extreme weather is the most common cause of power outages, which in restaurants, cause food spoilage, disrupt access to cooking and preparation tools, and reduce availability of ingredients due to supply chain disruptions. The environmental impacts become economic shocks through these events, which are then propagated through the food supply chain, leading to a higher cost for produce and meats, and higher prices for consumers.



### Tim McDiarmid

**Chef and Founder**

**Tim the Girl Catering and  
The Good Kind Café  
San Antonio, TX**

“San Antonio, South Texas, was built on outdoor dining—a lot of people don't have indoor space. Getting customers is challenging because climate change is not only the heat, now we're having ice storms. I have this gorgeous property here, but we've lost a lot of money. And anyone with money leaves town, because it's unlivable here now. You know, I think it was a hundred days of over a hundred degrees and it's 90% humidity.”

## Implications for Local Food Supply Systems

Our use of “local” reflects the USDA definition, describing local food as “400 miles from the origin of the product, or within the state in which the product is produced.” The importance of local food in the U.S. has been increasing. Agricultural surveys have

found that local sales are increasing; farms sell almost \$11 billion of edible food commodities directly to consumer outlets and intermediary supply chains, a nearly \$3 billion (35%) increase from 2019. Some of this growth has been fostered by the growth of food hubs—businesses or other organizations that aggregate, distribute, and market local and regional food products—which grew almost three-fold between 2007 and 2014. Many restaurants develop close relationships with local farmers, who they can rely on to provide fresh, high-quality produce and other ingredients. Local food producers now sell 76% of their products directly to consumers, markets, and institutions. These relationships benefit farmers, who can sell their products directly to restaurants at a fair price. Restaurants in the U.S. are also sourcing more local food, driven by customer demand, a desire to support the local economy, and a commitment to sustainability.

Our research goal is to chart a course that transforms vulnerability into resilience, leveraging the strengths of independent restaurants and local food supply systems. We envision a future where these restaurants thrive, bolstered by resilient local networks, sustainability, and a shared commitment to our society's well-being. This mission isn't just about culinary passion; it's about safeguarding our diverse cultural heritage, supporting our communities, and fortifying our very sustenance. Together, we can build a future where the power of food binds us in prosperity and harmony, creating a better, more sustainable world.



## **Sonya Cote**

**Founder and Chef  
Eden East Farm and  
The Storehouse Market  
and Eatery  
Austin, TX**

"We've had 100-degree weather out here and that kills everything including my partner, the farmer manager. He almost didn't make it this summer because it was just so strenuous in the heat. So, it's been a real struggle to try to financially keep up with the climate change and it's devastating, especially after moving [to] a five-acre organic vegetable farm and with the idea that we would be able to kind of keep trucking along and we just haven't had that opportunity since the weather has been such an up and down situation."

# Landscape of Independent Restaurants

## 1.1 Economic Impact of Independent Restaurants

The independent restaurant industry is a large sector of the U.S. economy. Market research conducted by IBISWorld on “Single Location Full-Service Restaurants” in the U.S. projected that this segment of the industry—157,000 restaurants—will generate \$209 billion in revenue in 2023.<sup>i</sup> This number is an underestimate of the full market revenue, since many chef-owned restaurants have more than one location but are not a franchise or corporate chain. These independent restaurants are owner/operator run, have thin margins, focus on local sourcing, and have operational autonomy. In addition to high revenues, of the 15.5 million workers employed by the entire restaurant industry,<sup>ii</sup> the independent restaurant industry is the fifth-largest employer in the U.S., employing 3.9 million workers<sup>iii</sup> (2.9% of the U.S. workforce<sup>iv</sup>) and paying \$75 billion in wages.<sup>i</sup>

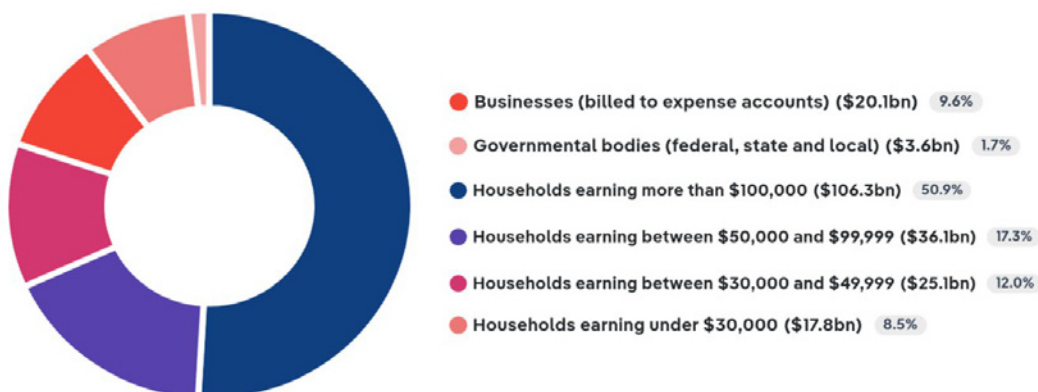
The restaurant industry boasts a diverse employee base with the most minority managers of any

industry.<sup>v</sup> Additionally, 41% of all restaurants are minority owned.<sup>v</sup> Geographically, the industry is heavily concentrated around large population centers. California, Florida, New York, and Texas contain 36% of all independent restaurants’ establishments, revenue, and wages, and 35% of all independent restaurants’ employees.<sup>i</sup>

Restaurant revenue is also highly segmented among socioeconomic groups (*Figure 1*). U.S. households earning more than \$100,000 annually accounted for more than half of total spending (\$106.3 billion in revenue), the majority of which was spent at fine-dining restaurants.<sup>i</sup>

## 1.2 Survival Rates of Independent Restaurants

Restaurant industry revenue has consistently increased since 2004, with the exception of the two major recessions during the period, namely the Great Recession (2008-2009) and the COVID-19 pandemic (2020-2022).<sup>i</sup> Independent restaurants’ survival rates depend on key factors such as competition with



*Figure 1.*  
Independent restaurants’ major market revenue segmented by socioeconomic groups and key markets, Source: IBISWorld Inc.<sup>i</sup>

chain restaurants, economic recessions, supply chain stability, and evolving consumer preferences. In their 2005 study, Parsa, Self, Njite, & King<sup>vi</sup> shed light on why independent restaurants often grapple with a high risk of failing from an economic perspective. A myriad of challenges plagues these establishments, including dwindling profits and inadequate financial management, which can lead to bankruptcy, foreclosure, or takeover by creditors.

Figure 2 graphically compares the rate of restaurant failures over a 20-year period, dispelling the myth of a 90% failure rate and demonstrating a 30% first-year failure rate.<sup>vi</sup> Although this model illustrated a 30% failure rate, most current studies<sup>vi-viii</sup> find that first-year failure rates are actually below 30%.

More specific data in Table 1<sup>vi</sup> shows that failure rates are around 26% in the first year, 19% in the second year, and 14% in the third year — a 59% failure rate over three years. This finding underscores the formidable challenge of starting and sustaining a new independent restaurant.

These rates are higher than their chain-affiliated counterparts<sup>vi</sup> which may reflect the advantages conferred by established brand recognition and the substantially greater resources that chains typically possess.

Figure 3<sup>viii</sup> underscores a stark disparity in the percentage of restaurants failing in their inaugural year during economic recessions (16% in 2008 and 20% in 2009) compared to economic recoveries (13% in 2011 and 5% in 2012). Particularly noteworthy is the peak of restaurant failures in 2009, which was nearly four times the failure rate observed in the more prosperous economic climate of 2012. These results are consistent with previous research by Kalnins and Mayer (2004),<sup>ix</sup> which also highlighted the superior survival rates of chain restaurants, revealing that independent restaurants face failure rates 2.5 times higher. These observations illustrate the restaurant industry’s sensitivity to fluctuations in the economic landscape.

Smaller and less complex restaurants tend to fail sooner, while larger and more complex restaurants exhibit greater resilience. A study<sup>vi</sup> in 2019 pinpointed



Figure 2. Comparison of first-year restaurant failure rates.<sup>vi</sup>

	Year One	Year Two	Year Three	In Business	Total
Total ROT	638	1,107	1,457	982	2,439
ROT percentage per year	26.16	19.23	14.35	40.26	100
Cumulative percentage	26.16	45.39	59.74		
Number of independent restaurants failed	408	699	910	573	1,483
ROT percentage	27.51	19.62	14.23	38.64	100
Cumulative percentage	27.51	47.13	61.36		
Number of chain restaurants failed	230	408	547	409	956
ROT percentage	24.06	18.62	14.54	42.78	100
Cumulative percentage	24.06	42.68	57.22		
Ratio of independent to chain restaurants	1.77	1.71	2.22	1.40	1.55

Table 1. Restaurant Ownership Turnover 1996-1999<sup>vi</sup>

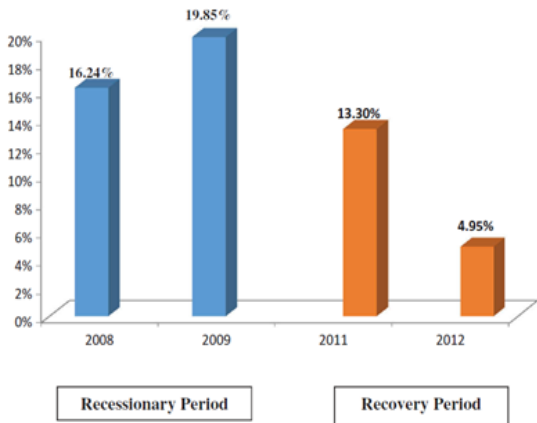


Figure 3. Restaurant Failure During and After Recession<sup>vii</sup>

various factors contributing to restaurant failure, including insufficient funding, unfavorable location, limited foot traffic, an unsatisfactory atmosphere, and subpar management. The research emphasized the critical influence of managerial actions on organizational decline and failure.

## Summary of the Main Points

### Economic Impact of Independent Restaurants:

Independent restaurants are the fifth-largest employer in the U.S., employing 3% of the U.S. workforce and paying almost \$75 billion in wages. Restaurants boast a diverse employee base with the most minority managers of any industry. Additionally, 41% of all restaurants are minority-owned. Independent restaurants are highly vulnerable to failure. For example, 26% fail in their first year of operation, 19% fail in the second year, and 14% fail in the third year — a 59% failure rate over three years. These rates are higher than their chain-affiliated counterparts, which may reflect the advantages conferred by established brand recognition and the substantially greater resources that chains typically possess.

### Survival Rates of Independent Restaurants:

The restaurant industry revenue has generally increased, except during major recessions like the Great Recession (2008–2009) and the COVID-19 pandemic (2020–2022). Independent restaurant survival rates are influenced by factors such as competition with chain restaurants, economic recessions, supply chain instability, and evolving consumer preferences. Contrary to the common belief of a high failure rate, studies show a more moderate first-year failure rate of below 30%. The first year presents the most significant challenge, with substantial turnover in ownership. Independent restaurants face a higher closure rate compared to chain-affiliated counterparts due to factors like brand recognition and resource availability. Restaurants have an average lifespan of roughly 4.5 years but the longer a restaurant is open, the greater the chance of survival.

**Role of the Economy:** The economy plays a substantial role in the success of a restaurant, as restaurants are vulnerable to changes in the economic landscape. In 2009, restaurant failure rates reached 19.85%, nearly four times the failure rate witnessed during the robust economic climate of 2012 (4.95%). When the economy rebounded, the number of active restaurants increased by approximately 20%, while failure rates declined by 15%.

## Conclusions

- **Economic Significance:** Independent restaurants play a vital role in the U.S. economy, contributing significantly to revenue generation and employment. Their impact is diverse, spanning employment, wages, and minority representation in the workforce.
- **Revenue Segmentation:** The revenue distribution of independent restaurants is stratified across socioeconomic groups, with higher-income households contributing the majority of spending.
- **Survival Challenges:** Independent restaurants face a range of challenges, leading to a significant failure rate, especially within the first three years. These challenges include economic factors, competition with chain restaurants, and evolving consumer preferences.
- **Comparison with Chains:** Independent restaurants have a higher closure rate compared to chain-affiliated counterparts. Established brand recognition and resource availability contribute to the higher survival rates of chain restaurants.

## 1.3 Future Growth

The industry has almost fully recovered from the dip due to COVID-19, with 2023 revenue projected at 99% of 2019. However, future projections from IBISWorld estimate that this growth will not be sustained in the long term. Projections show that revenue may decrease beginning in 2027 (*Table 2*).<sup>1</sup>

This projected decrease in growth can be attributed to the expected increases in the price of food supply. Because ~40% of independent restaurants' costs come from purchases (i.e. food and machines) (*Figure 4*), inflation of food prices will drastically affect the independent restaurant community. The impact will vary drastically in response to global efforts to reduce climate change.

**Climate Change.** A study from the European Central Bank estimates that by 2035 in a best-case scenario of drastically decreased emissions, inflation will



increase U.S. food prices by an additional 0.4-2.6%. If emissions are not drastically reduced, inflation could rise as much as 3.3% over its current values.<sup>x</sup> This price inflation prediction can be directly tied to the impact of climate change on crops. A 2017 study from the National Academy of Sciences estimates that for every 1°C increase in global temperature, substantial losses will be seen in production of wheat (-6.0%), rice (-3.2%), maize (-7.4%), and soybean (-3.1%), the four major staple grains that supply 2/3 of the world's caloric intake.<sup>xi</sup> The impact of these losses on undernutrition and micronutrient malnutrition and will be amplified by the projected increase in the climate-related disruptions.

This future inflation can be tied to historical trends as well. Since 1961, climate change has caused a 21% decrease in global agricultural productivity

equalling a loss of 7 years of production since the 1960s. Warmer regions such as Africa and Latin America are experiencing an even more severe effect (26-34% decrease).<sup>xii</sup>

## Summary of Main Points

**Impacts of Climate Change:** The restaurant industry seems to have made a full recovery from losses due to COVID, with 2023 revenue projected at 99% of 2019. But according to future projections from IBISWorld, this growth is temporary, and won't be sustained in the long term. Estimates indicate that revenue will begin to decrease in 2027, likely due to the projected increase in the price of food supply. As climate change progresses, with every 1°C increase in global temperature, extensive losses will be seen in production of wheat, rice, maize, and soybean, four key

## Industry Data

Year	Revenue (\$ million)	IVA (\$ million)	Establishments (Units)	Enterprises (Units)	Employment (Units)	Wages (\$ million)
2004	147,240	58,517	138,715	123,299	2,451,068	49,212
2005	149,760	59,512	140,136	124,406	2,481,724	49,978
2006	153,987	61,823	141,492	125,290	2,562,209	52,011
2007	156,686	63,909	145,335	128,269	2,584,263	53,787
2008	154,942	63,350	147,272	129,775	2,656,658	54,208
2009	151,970	63,558	148,149	130,548	2,552,014	53,680
2010	153,092	64,830	150,979	133,497	2,531,078	54,726
2011	159,993	65,844	151,150	133,763	2,553,625	55,605
2012	166,364	68,940	150,522	132,961	2,656,018	57,461
2013	171,102	73,424	153,681	136,060	2,732,829	61,446
2014	178,302	75,885	153,734	136,187	2,781,585	63,404
2015	187,734	82,273	152,809	135,228	2,832,633	67,254
2016	196,500	87,271	156,902	138,765	2,973,263	71,944
2017	198,970	86,371	157,245	139,193	2,961,601	72,045
2018	204,359	89,234	159,689	141,983	3,003,112	74,111
2019	210,742	91,521	159,074	141,486	2,990,280	75,504
2020	158,335	64,906	154,970	138,328	2,894,679	55,893
2021	187,288	74,420	166,427	147,566	3,260,009	63,580
2022	206,652	81,365	174,492	154,178	3,509,546	68,787
2023	208,911	82,579	177,308	156,715	3,566,586	69,832
2024	211,458	83,868	180,097	159,214	3,623,542	70,894
2025	214,640	85,362	183,345	162,112	3,691,359	72,169
2026	217,473	86,835	186,554	164,982	3,756,446	73,377
2027	220,517	88,399	190,221	168,272	3,828,444	74,708
2028	211,249	85,911	190,438	168,925	3,764,552	73,082
2029	170,876	73,087	178,111	159,414	3,300,006	63,074

Table 2. Historic data and future financial impact of independent restaurants<sup>i</sup>

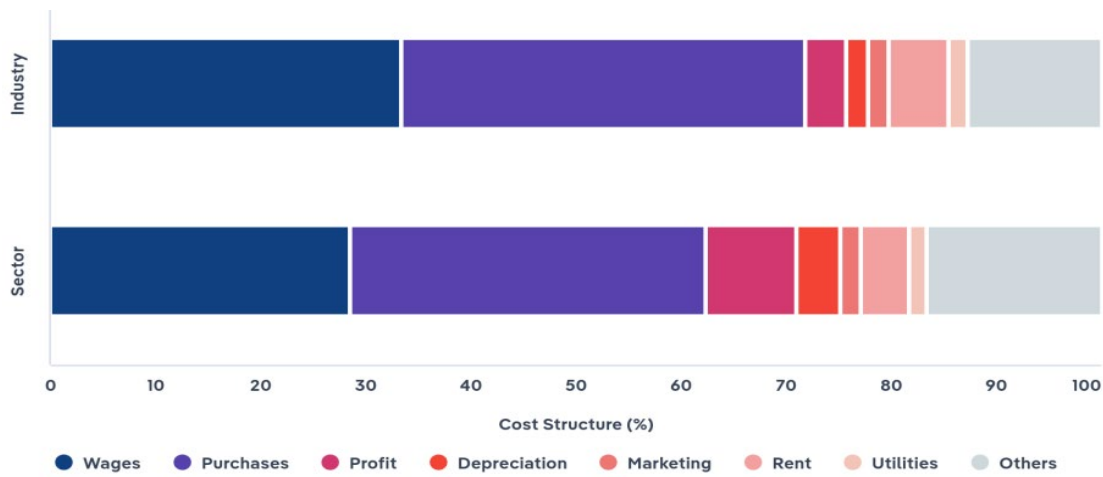


Figure 4. Structure of average operating costs by independent restaurants in 2023,  
Source: IBISWorld.<sup>1</sup>

staple grains that account for  $\frac{2}{3}$  of the world's caloric intake. Low crop supply will cause inflation, changing the U.S. food inflation from 0.4% up to 3.3%.

## Conclusions

- **Poor Crop Productivity:** The increasing global temperature will result in profound losses in the production of key global crops, including wheat, rice, maize, and soybean. Warmer regions such as Africa and Latin America will experience the most severe effects.
- **Inflation:** The decrease in the global supply of crops due to climate change will result in widespread inflation, resulting in a projected decrease in revenue of the U.S. restaurant industry.

# Global Food Supply Chain

## 2.1. Landscape of the Food Supply Chain in the U.S.

In 2021, agriculture, food, and food-related industries contributed approximately 5% of the country's GDP, or over \$1 trillion. This sector was also responsible for the utilization of around 44% of the nation's land.<sup>xiii</sup> The U.S. is a major player in the global grains market, supplying nearly 25% of grains worldwide, and this agricultural production is reflected in the nation's food preferences through the success of processed and ultra-processed foods created from these grains.<sup>xiii-xv</sup>

California and the Midwest account for most of the crop production, while livestock is much more widely distributed across the country.<sup>xvi</sup> In the West Coast region specifically, fruits and vegetables are typically sold in the highest quantities.<sup>xvii</sup> When assessing the U.S. involvement in national and global food supply chains, farms are typically divided into three categories: small (less than 50 acres), mid-size (50–999 acres), and large-scale farming (greater than 999 acres).<sup>xviii</sup> The number of farms in the U.S. is decreasing, with fewer but wealthier operations.<sup>xvi</sup> Despite this decrease, and a steady decrease in total farmland, overall food production in the U.S. continues to increase at a constant rate.

Between 2012 and 2017, the total number of farms decreased by 67,000, from over 2.1 million farms, to roughly 2 million total farms in 2017.<sup>xviii</sup> By 2022, that number continues to decrease by the thousands, threatening to drop below the 2 million mark in the coming years.<sup>xvi</sup> The total farmland in the U.S. has also been consistently decreasing. In 2012 there was approximately 915 million acres of land used for farming, and in 2017 that number fell to just over 900

million; a loss of about 14.3 million acres.<sup>xviii</sup>

By 2022, that number dropped below 900 million acres.

<sup>xvi</sup> Farmland is a broader term that encompasses all land used for agricultural purposes, including cropland, pastureland, and rangeland. Pastureland and rangeland are primarily used for livestock, whereas cropland is land that is used to cultivate crops like wheat fields, cornfields, orchards, vineyards, etc. The U.S. has seen a steady decrease in overall farmland over the past few years, however cropland has increased. In 2012, approximately 390 million acres of land was allocated for cropland. By 2017 that number rose by roughly 7 million, bringing the total land used for crops to around 397 million acres. Furthermore, harvested cropland also increased in that five-year window. In 2012 there were 315 million acres of harvested cropland, and in 2017 there was roughly 320 million.<sup>xviii</sup> Cropland also includes a wide range of crops broken down in three distinct categories: food crops, feed crops, and other crops. The most relevant category to restaurants is food crops, which include specialty crops such as potatoes, fruits, and vegetables. Specialty crops in 2017 occupy around 76 million acres in the U.S., a fraction of total cropland.<sup>xvii</sup>

In comparison, pastureland in 2017 occupied approximately 415 million acres of land. Yet this number, and the number of farms dedicated toward livestock is shrinking. In 2012 the number of cattle farms decreased from 913,000 to 882,000 in 2017. Despite this decrease however, the number of cattle within these farms grew from 89 million in 2012 to 94 million in 2017. The same inverse relationship can be seen with feed crops such as feed corn produced for animal consumption. In 2012 the number of farms producing feed corn was 349,000. In 2017 that number decreased to 305,000. However, the bushels of corn yielded rose from 10.3 billion in 2012, to 14.8 billion in 2017.<sup>xviii</sup>

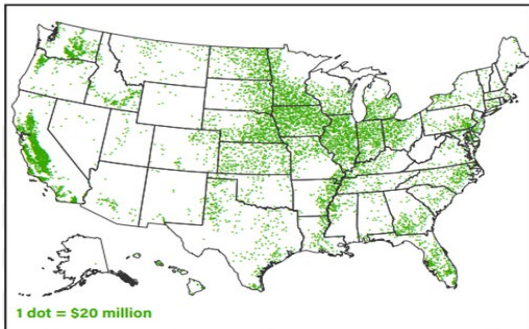
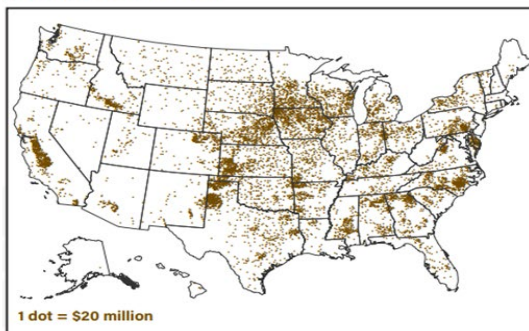
**Market value of crops sold in 2017****Market value of livestock, dairy, poultry, and their products sold in 2017**

Figure 5. Market value and distribution of crops versus livestock, dairy, and poultry products in the U.S. <sup>xli</sup>

The landscape of food production in the U.S. is undergoing significant changes. Due to a variety of factors such as overcrowding animals, or technological innovation, the productivity of these farms has dramatically increased, thus generating higher returns. In 2022, the U.S. gross farm income was approximately \$600 billion, nearly doubling from 2002.<sup>xvi</sup> While the overall production of food in America is on the rise, the number of traditional farms, and the overall amount of farmland across the country, is dwindling. Paradoxically, American cropland is expanding; however, it's not necessarily leading to an increase in food crops, specialty crops, or more specifically vegetable production. Instead, the growth in cropland is predominantly geared towards other industries or sustaining a growing livestock industry. For example, in 2012 we saw cotton rise from 9.3 million acres to 11.4 million acres by 2017. In 2012 we saw soybean rise from 76.1 million acres to 90.1 million acres in 2017.<sup>xviii</sup>

The big takeaway from these data is that despite the reduction in overall farm acreage, farmers are

intensifying their operations to accommodate more animals in smaller spaces, with the aim of achieving higher productivity and returns. By highlighting this trend, we see that the American farming industry is becoming increasingly centered on meat production. As of 2017 the commercial value of livestock, poultry, and their products was more than four times larger than the combined commercial value of vegetables, melons, potatoes, sweet potatoes, fruits, tree nuts, and berries; and that gap is only widening (Figure 5).<sup>xviii</sup> Total revenues for vegetable farming alone in 2022 were approximately \$21 billion, down from last year, even with vegetable prices continuing to rise.<sup>xx</sup> In comparison, the meat industry continues to be the U.S.'s largest food sector in 2022, totaling almost \$300 billion.<sup>xxi</sup>

Long-distance food transportation is a defining feature of the U.S. food supply chain, with an average delivery distance of 1,640 km (1,020 mi) and a life-cycle supply chain of 6,760 km (4,200 mi).<sup>xxii</sup> These large spatially concentrated networks have also been impacted by increased pricing from fuel to staffing.



## Brandon Whitestone

**Chef and Culinary Director  
Alexander Restaurant Group  
Florida and Virginia**

"There is always something, there is never not something that we are challenged to source. Whether it's cost like romaine lettuce [that] went from \$28/case to over \$200/case or tomatoes from Italy stuck in port because of transportation issues, it comes down to consistency issues."

Food Transportation Cost Increases	
Packing Supplies	30% increase
Wooden Pallets	75% increase
Refrigerant	200% increase
Freight	40% increase
Corrugated Boxes	17% increase

Table 3. Increased transportation costs<sup>xxiii</sup>

Restaurants and bakeries are highly vulnerable to supply chain issues given their reliance on specialty ingredients, specialized equipment, and other commodities.

Production has recently slowed throughout the entire supply chain on food items such as cooking oil, grain, and meat. Shortages on wheat, soybean oil, and emulsifiers impact bakeries and restaurants alike as demand has exceeded the current supply. Wheat prices are three times higher than pre-pandemic prices, and spices and seasonings typically imported from India are more expensive and suffer from the same clogged supply chains.<sup>xxiv</sup>

Ukraine and Russia produce 28% of the world's grain and wheat, but exports from both countries have stalled—impacting the global supply chain as depicted in Figure 6.<sup>xxiv</sup> Wheat and grain prices have increased 48%, causing restaurants to either raise the prices of grain-based items or find alternate flour suppliers.

Some restaurants have eliminated wheat from their menus.<sup>xxiv-xxv</sup> Most baking facilities, including those that supply restaurants, are unable to manufacture 10 to 15% of their product line due to these shortages.<sup>xxiv</sup>

Although the vast majority of food is domestically sourced, the U.S. supply chain suffers from inconsistencies in product availability and inflation.

<sup>xxv</sup> Costs are passed on to restaurants, with 92% reporting significant issues due to rising food costs. 43% of restaurants report fierce competition with other restaurants.<sup>xxv</sup>

## Summary of Main Points

### Reduction in Acres, Increase in Production:

Farmland in the U.S. has steadily decreased over the past decade, falling from 915 million acres to below 900 million acres in 2022. In 2012, there were 913,000 cattle farms, which fell to 882,000 in 2022. Despite the decrease of cattle farms, the number of cattle increased from 89 million to 94 million over this timespan. This trend can also be observed with feed crops, grown and harvested to feed livestock like cows, horses, pigs, and sheep, with a decrease in the number of farms producing feed corn, yet an increase in corn bushel yields during that time span. Although there has been a reduction in total farm acreage, farmers are ramping up their efforts to allow for a larger quantity of animals and crops in smaller spaces. This has resulted in higher productivity, with higher returns. Over the past two decades, the U.S. gross farm income has nearly doubled.

### Supply Chain Shortages Increasing Prices: The

U.S. food supply chain relies on long-distance food transportation. Recently, production of several key ingredients has slowed throughout the entire food supply chain, including cooking oil, grain, and meat. Moreover, Ukraine and Russia are top suppliers of the world's grain and wheat, but due to the war, exports have been delayed, resulting in a 48% increase in wheat and grain prices. Restaurants are left with few options: raise prices of grain-based dishes, find different suppliers, or cut out wheat products from the menu altogether. As a result of these shortages, baking facilities are unable to create 10-15% of their product line. These costs are then borne by restaurants, with 92% of restaurants citing issues from rising food costs.

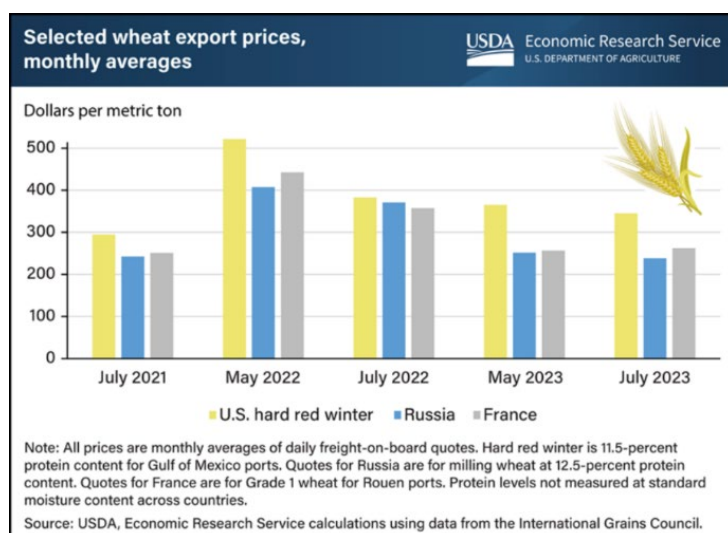


Figure 6. Wheat export variations due to supply chain disruptions<sup>xxiv</sup>



## Conclusion

- **Productivity:** Although there has been a reduction in the number of farms and the amount of acreage in the US, food production has continued increasing at a steady rate.
- **Focus on Meat Production:** By keeping a large number of animals in small spaces, farmers are aiming to reduce costs, while gaining high productivity and returns. These intensive measures indicate how the U.S. farming industry has become increasingly focused on meat production. In 2022, total revenues for vegetable farming were \$21 billion, while the meat industry totaled \$300 billion.
- **Price Increases:** Restaurants are vulnerable to supply chain disruptions. Numerous ingredients' production has slowed down, including wheat, spices, cooking oil, grain, and meat. The low availability of key ingredients has caused a spike in prices, financially impacting restaurants. Restaurants must make difficult decisions regarding how they choose to navigate these supply chain issues.

## 2.2 Imports

Although the U.S. sources the majority of its food domestically, there is a growing reliance on imported produce. Over the past two decades, the U.S. has imported agricultural and livestock products valued, on average, at \$102 billion. In 2021, this value increased to \$171 billion, accounting for 17.4% of the consumed food. Of this, 52% were horticultural products (such as fruits, vegetables, tree nuts, wine, spirits, essential oils, and nursery stocks), 15% were sugar and tropical products like coffee and cocoa, 13% were animal and meat products, 9% were grains and feeds, 8% were oilseed products, and the remaining 3% comprised other items.<sup>xiv</sup> Vegetable imports grew from 20 to 38% from 2007 to 2021, while fruit imports grew from 50 to 60% during that same time period. Blueberries, asparagus, tomatoes, cauliflower, avocados, cucumbers, bell peppers, raspberries, broccoli, and snap beans were associated with an increase of more than 20% from 2007 to 2021.<sup>xxvi</sup>

A specific example of increased imports and a decrease in domestic production is chili peppers.

Producers in New Mexico, California, Texas, and Arizona grew over 480 million pounds of chili peppers in 2014. This number dwindled to 175 million pounds in 2022. The principal drivers of this 60% reduction were identified by the USDA to be diminished acreage and reduced yields.<sup>xxvii</sup> In response to declining domestic production and the burgeoning demand for peppers, U.S. consumers and companies purchased imported peppers, predominantly sourced from Mexico. Around two out of every ten chili peppers consumed domestically were of domestic origin in 2014. As of 2022, this ratio (*Figure 7*) had dropped to less than one out of every ten. Nonetheless, the quantity of exports remained relatively stable during this eight-year period, with fluctuations between 66 million pounds to 106 million pounds. The share of U.S. chili peppers in the export market more than tripled from 14% in 2014 to 46% in 2022. Despite an 8% overall increase of available chili peppers, fewer of these peppers were grown by U.S. producers.<sup>xxvii</sup>

Although we are shifting our imports, the U.S. remains one of the top agricultural producers; and as the world's primary food exporter, the U.S. imports just around 20% of the food it consumes. Of the 20% of

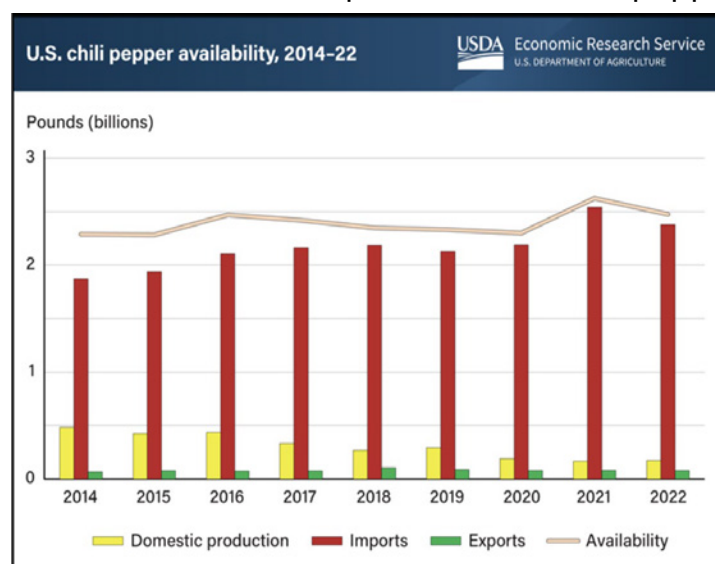


Figure 7. Changes to import versus U.S. domestic production of chili peppers <sup>xxvii</sup>

food imported, the U.S. horticultural products, which include fruits, vegetables, and tree nuts, as well as sweeteners, processed sugar, and confections comprise the majority of those 20% imported goods.

Figure 8 illustrates the consistent growth of U.S.'s agricultural imports over the last 20 years, primarily driven by the rising demand for a variety of consumer-oriented products. From 2001 to 2021, the value of

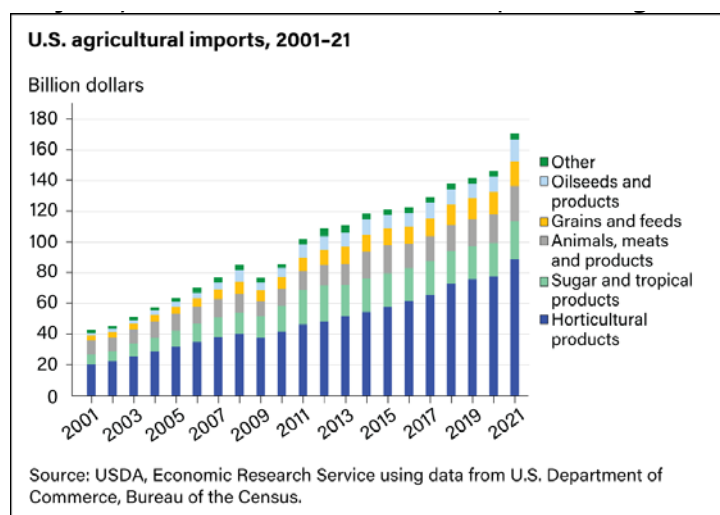


Figure 8. Change in U.S. agricultural imports 2001-2021 USDA ERS - Agricultural Trade<sup>xiv</sup>

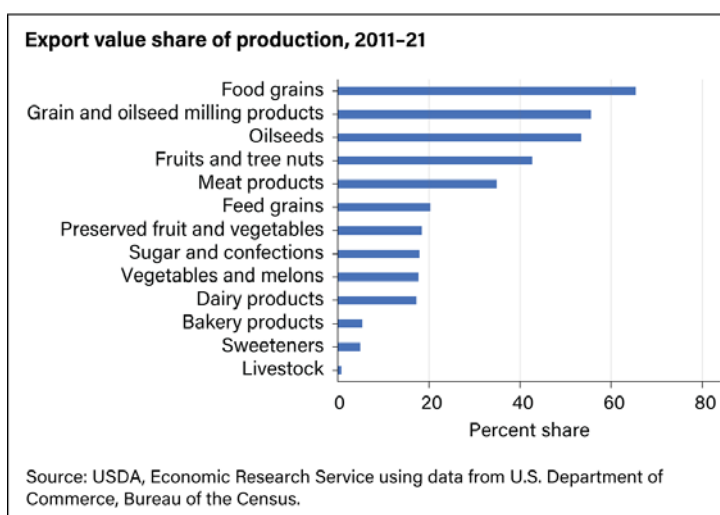


Figure 9. Import share of U.S. food consumption, 2011-2021, Source: USDA ERS - Agricultural Trade<sup>xiv</sup>

these imports quadrupled, amounting to 171 billion in 2021.<sup>xiv</sup> Since 2001, consumer-oriented products have led the surge in U.S. agricultural imports, seeing an annual growth of about 7%. The U.S. demand for diverse foods throughout the year has boosted imports of horticultural items during their off-season domestically.<sup>xiv</sup> In 2021, these horticultural items represented over half of the U.S.'s agricultural imports. Meanwhile, sugar and tropical goods made up around 15%, and animal-related products comprised roughly 12% of the imports. The reduction in the value of imports in 2009 resulted from the Great Recession, which strengthened the dollar against most other foreign currencies.<sup>xxviii</sup> Therefore, the reduction does not necessarily indicate a decrease in the volume of imports. The stronger dollar reduced the value of U.S. imports by making them less expensive.

Figure 9 displays the percentages of imported food products from 2011 to 2021. The U.S. share of agricultural consumption sourced from imports tend to be higher for higher-value agricultural product groups. This trend is influenced by a range of factors, such as production competitiveness, seasonal availability, and consumer tastes. The U.S. heavily depends on imports for items like sweeteners, processed sugars, and candies. There's also a significant import of fruits, nuts, and vegetables. From 2011 to 2021, the import ratio for all food and drinks in comparison to all import items was 15%, with a consistent rise throughout the decade.<sup>xiv</sup>

Figure 10 displays the increase in U.S. import volumes of fresh vegetables from major vegetable trading countries. Over the past two decades, the volume of fresh vegetables imported by the U.S., mainly from Mexico and Canada, has increased by nearly 200% due mainly to consumer demand for year-round availability of these produce.<sup>xxix</sup>

## 2.3 Customer Spending

Over the past 20 years, real (inflation-adjusted) annual food spending in the U.S. increased from 1997 to 2022, except for setbacks in 2008-2009 during the Great Recession and in 2020 during the COVID-19 pandemic. This spending encompasses two categories:



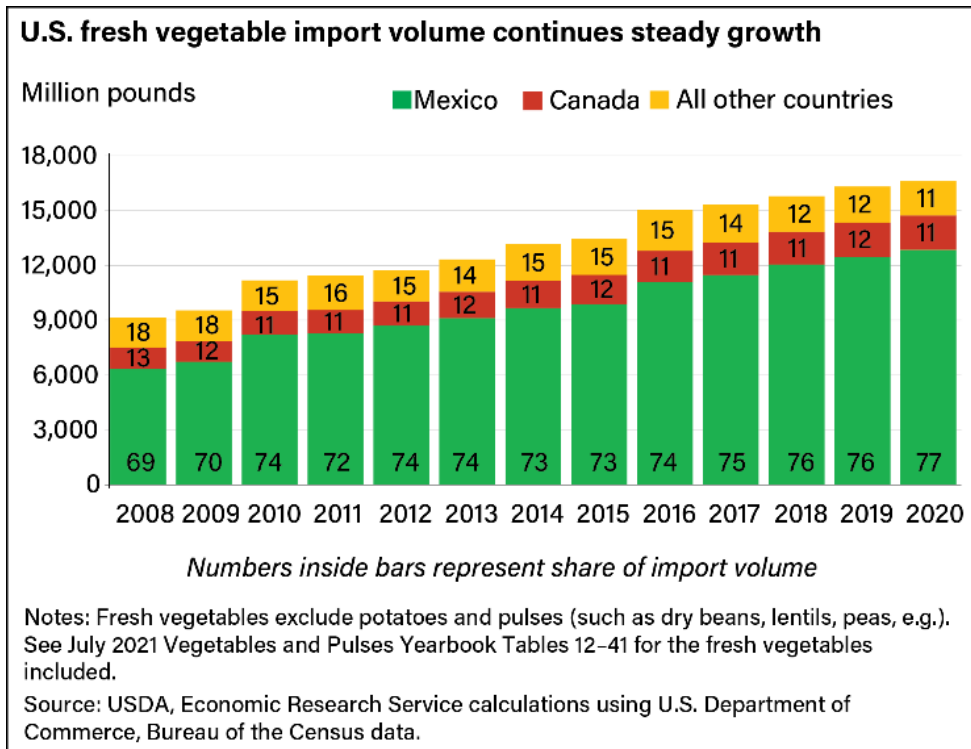


Figure 10. Import volume of U.S. Fresh Vegetables, Source: USDA ERS - Charts of Note<sup>xxxx</sup>

food at home (FAH), like groceries from stores, and food away from home (FAFH), such as restaurant meals. Overall food spending surged by 70% from 1997 to 2022 (Figure 11), driven more by FAFH (89% increase) than FAH (53% increase).<sup>xxx</sup>

For context, the U.S. population grew by approximately 66 million people from 1997 to 2022, or slightly less than 25%. Given the disproportionate rate of growth between these two figures, it is clear consumer habits greatly favored increased food spending. Moreover, in 2021, there was a 7.2% annual increase in total food spending, followed by a 4.5% rise in 2022. The growth was primarily fueled by increased spending on FAFH (19% in 2021 and 8% in 2022), while FAH spending grew by 4% in 2021 but dipped by 2% in 2022.<sup>xxx</sup>

How Americans chose to spend their money over the years is also telling. In 2022, Americans allocated about 6% of their incomes to buying groceries from various retail outlets, while 6% was spent on dining out at restaurants, schools, and fast-food places. The sharpest change in the percentage of income spent on



## Christine Ha

**Chef and Founder**

**Blind Goat and Stuffed Belly  
Houston, TX**

“Everyone thinks the charm of Vietnamese food as being dirt-cheap street food, so it's not feasible for me to pay more to source ingredients, then charge a lot more for dishes and still have repeat customers. Ideally, I would love to support the local farmers, and we have from time to time, but we have found that with this industry—though I'm fairly new to it—it's been very difficult to have good margins in the restaurant.”

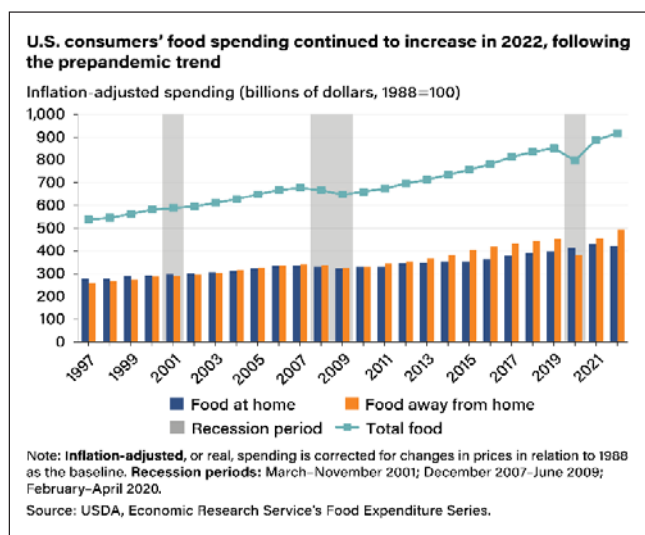


Figure 11. Tracking inflation adjusted food spending for FAH and FAFH<sup>xxx</sup>

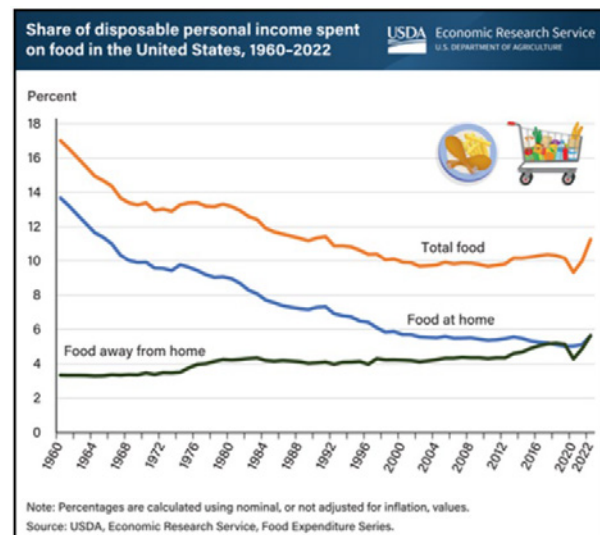


Figure 12. Personal income spent on FAH and FAFH<sup>xxxi</sup>

food occurred in 2022 (Figure 12), with a 13% increase. This followed an 8% decline in 2020, which was the most significant drop in food spending since 1967. These fluctuations were mainly due to changes in consumer behavior brought about by the COVID-19 pandemic, with people initially dining out less but gradually returning to eating out as pandemic-related restrictions eased.<sup>xxxi</sup>

## Summary of Points

**American Food Spending Habits:** Annual food spending in the U.S. increased by 70% from 1997 to 2022, discounting decreases during the Great Recession and the COVID-19 pandemic. There was an 89% increase in food away from home, such as restaurant meals, in comparison to a 53% increase in food at home. In 2022, Americans spent nearly identical portions of their income on buying groceries in comparison to dining out.

## Conclusion

- **U.S. Imports:** The majority of the food consumed by the U.S. is produced domestically, but trends indicate that the U.S. has gained a dependency on importing horticultural products, such as sweeteners, sugars, fruits, vegetables and nuts.
- **Increase in Food Spending:** Overall, food spending has increased over the past 25 years, with meals away from home increasing at a higher percentage than meals at home. Notably, the average American today spends roughly the same amount on buying groceries as they do dining out.

# Effects of (Un)natural Disasters on the Food Supply

## 3.1 Disruptions

Climate change has already been associated with major disruptions of food production and supply. We choose to call these “(un)natural disasters” because they are driven by the increase in greenhouse gases generated by human activities. To call these events “natural disasters” ignores their true origin. They are a consequence of climate change, not a cause.

In the 2020 United Nations Office for Disaster Risk Reduction report, 4,212 reported natural disasters were recorded from 1980–1999.<sup>xxxii</sup> This increased in the next two decades to 7,348.<sup>xxxiii</sup> During these next two decades (2000–2019) climate-related disasters saw staggering incident increases including droughts at 28.5%, extreme temperatures at 232%, flooding at 134%, storms at 40%, and wildfires at 46%.<sup>xxxii</sup> This had a doubling of human deaths from 500,000 in the first two decades to over 1.2 million in the second two decades.<sup>xxxii</sup> And although this increase should be shocking, what is more disturbing are the trends of these disasters in the last 42 months (Jan 2020–Aug 2023). The global average annual record of storms has increased by 19%, floods by 23%, and wildfires by 29%.<sup>xxxiii</sup> These natural disasters can cause disruptions in the global food supply chain.

Recent global issues, such as the war in Ukraine and COVID-19, have made compelling studies on the vulnerabilities in the global food supply system. The war in Ukraine and resulting political conflicts resulted in looming wheat shortages and price increases<sup>xxxiv</sup> of grains and vegetable oils, while COVID-19 affected the supply chain at every

level, from labor issues<sup>xxxv</sup> to restricted food trade policies,<sup>xxxvi</sup> leading to shortages and increased food insecurity.<sup>xxxvii</sup> These worldwide emergencies have added fuel to the movement towards localized food systems, expressing the dangers of a food supply chain vulnerable to the fluctuations of international supply and demand, extreme weather, and political conflicts around the world. In particular in the U.S., we are concerned about droughts, extreme flooding events, wildfires, and power outages.

## 3.2 Impacts of Drought on the Food Supply Chain

Farmers receive indemnity payments from the USDA for various reasons, but one of the fastest-growing types of indemnity payments is weather-related reductions in crop yield.<sup>xxxviii</sup> Drought along with excess moisture from flooding due to a large storm like a hurricane or excessive rainfall due to more intense storms are the top weather-related indemnity payments causing crop loss. According to data presented by Environmental Working Group through USDA Risk Management Agency, drought is the highest-paid weather-related indemnity over the period of 1995–2020.<sup>xxxviii</sup> The total payments for drought over this period were \$48.6 billion.<sup>xxxviii</sup> In 1995, the total payment for drought indemnities were \$325.6 million.<sup>xxxviii</sup> In 2020, drought related indemnity payments were \$1.65 billion.<sup>xxxviii</sup> This is a drastic difference that will likely continue to significantly increase as climate change progresses. *Figure 13* shows that over time, drought indemnities increased between 1995 and 2020.<sup>xxxviii</sup> The large spike in indemnity



Figure 13. Drought Indemnities over Time, Source: Schechingel<sup>xxxviii</sup>

payments in 2011 and 2012 illustrates the relationship between drought and indemnity payments over time. In fact, over the same period of 1995–2020, out of the entire U.S., the top 10 counties with the highest drought indemnities were all in the State of Texas.<sup>xxxviii</sup>

Texas is one of the U.S.’s largest agricultural producers, and the largest ranching state. California and Texas have the largest Gross Domestic Product (GDP) percentages of agriculture.<sup>xxxix</sup> At the same time, California and Texas are two of the states most affected by climate change; 2011 was a year of exceptional drought in the U.S., and particularly



## Felipe Riccio

**Chef and Partner  
and  
June Rodil**

**MS, Partner, and CEO  
March Restaurant,  
Rosie Cannonball,  
Montrose Cheese & Wine,  
and The Marigold Club  
Houston, TX**

“You see people only doing [as] local as possible because it is easier to source and less expensive. Peaches used to be easy to source but because of the droughts these farmers who used to be mainstays at farmers markets are now retiring because they lost 90% of their orchard. So, you’re not only losing these heritage peaches but also the farm and farmer.”

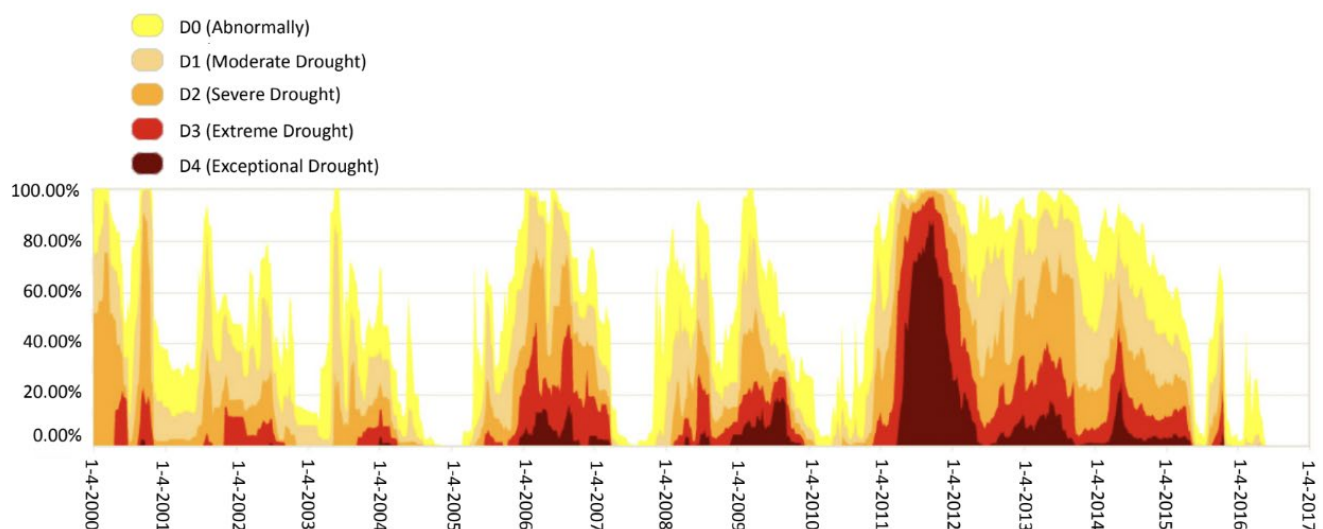


Figure 14. Percent of Texas Area affected by Drought 2000–2016, Source Ziolkowska<sup>xxxix</sup>

in Texas. In October of the same year, more than 90% of Texas was classified as being in “exceptional drought,” which is the highest drought rating.<sup>xxxix</sup> Figure 14<sup>xxxix</sup> illustrates the total percentage of areas in Texas affected by drought from 2000–2016.<sup>xxxix</sup> The large spike around 2011 and 2012 is the previously mentioned drought. Having upwards of 90% of a state in exceptional drought is an extremely serious agricultural challenge.

According to Ziolkowska et al., the observable drought in 2011 (Figure 14) caused upwards of \$7.6 billion in losses to the agriculture industry in Texas and lowered the agricultural GDP in the state to a mere 0.8%.<sup>xxxix</sup> For a state so dependent on agriculture, this was devastating. Upwards of 105,000 individuals lost their jobs in the agricultural sector alone.<sup>xxxix</sup> Climate change can also directly impact restaurants, as seen in the case of a small town in western Texas called Robert Lee. The town and its restaurants heavily depend on the E.V. Spence Reservoir to attract tourists and business. The 2011 drought led to the reservoir being 99.5% empty.<sup>xl</sup> Real estate, food tourism, and restaurants all suffered because of drought. Climate change is a problem that affects all aspects of the agricultural industry, from the producer all the way to the consumer. Moving forward, droughts will only worsen, and it is expected that economic ramifications will continue.

The Texas experience is not unique. A review conducted by Diffenbaugh et al. determined that county-level temperature trends have contributed to approximately \$27 billion (or 19%) of the national-level crop insurance losses over a period between 1991–2017.<sup>xli</sup> In addition, observed warming in 2012 contributed to almost half of the total losses in that year.<sup>xli</sup> Figure 15 was generated by Diffenbaugh et al. and shows the spatial relationship between crop indemnities and temperature over the period of 1991–2017.<sup>xlii</sup>

As Figure 16 shows, the greatest increases in temperatures between 2000–2022 overlap with the highest total indemnity payments.<sup>xliii</sup> These droughts mainly occur in the central U.S., ranging from Texas to the Dakotas and Montana. Most of the agricultural

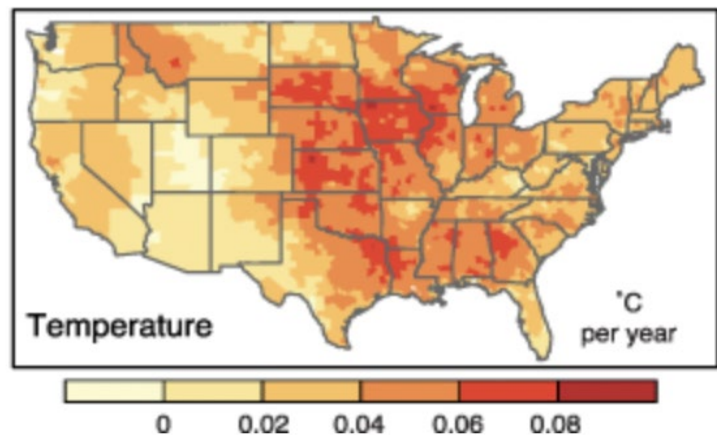


Figure 15. 1991–2017 U.S. Cumulative Total Crop Indemnities and trend in April – October temperature Source: Diffenbaugh et al.<sup>xxxix</sup>

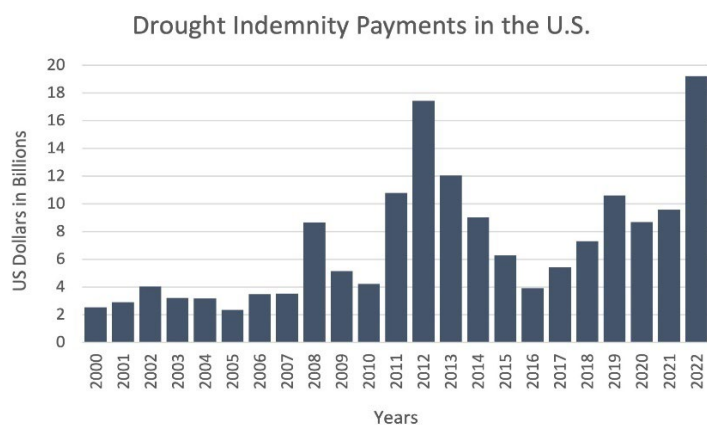


Figure 16. Drought Indemnity Payments over time in the U.S., Source: U.S. Department of Agriculture Risk Management Agency<sup>xliii</sup>

production and the greatest increase in temperature occurred in the central U.S., which accounts for the large number of indemnity payments in that general region.

## Summary of Main Points

**Drought Severity:** Between 1995 and 2020, the number of drought events remained relatively constant, but the drought events grew in severity. During this time period, drought indemnity payments in the U.S. increased five-fold, indicating the magnitude of climate-related crop yield reduction over the past few decades.

**Effects of Drought:** The 2011 drought in Texas illustrates the severe effects of drought on the



agricultural and as a result the restaurant industry. The drought caused over \$7.6 billion in losses to the agriculture industry of Texas, reducing the state's agricultural GDP to 0.8%. More than 106,000 employees in the agriculture industry lost their jobs. Other downstream effects include loss of customers due to severe weather conditions. This affects everything from local businesses from clothing shops, real estate, tourism to independent restaurants; all suffered financial losses as a result of the drought.

## Conclusion

- **Relationship Between Drought Severity and Crop Yield Reduction:** Over the years, drought indemnity payments have increased significantly, in response to the significant reduction in crop yield reduction observed during droughts. Although droughts do not occur more often, they are more severe than they used to be in the past.
- **Agricultural Consequences of Drought:** Significant losses to the agricultural industry were observed in the 2011 drought in Texas, causing the state's agricultural GDP to plummet. Thousands of employees in the agricultural sector lost their jobs as a result of the drought.

## 3.3 Impacts of Wildfires on the Food Supply Chain

Wildfires in the western U.S. have significant impacts on agriculture, including crop losses and damage to livestock and agricultural property. Wildfire smoke also poses health risks to agricultural workers and can affect soil properties and water quantity and quality, threatening agricultural systems, in turn affecting food supply chains that rely heavily on agriculture. There are 2.5 to 3 million agricultural workers in the U.S. who experience health risks and smoke exposure as a result of increased wildfires across the country, particularly in places where agriculture is a large contributor to the local and national economy.<sup>xliii</sup> Kabeshita et al.<sup>xliii</sup> describes the ways wildfires have an impact on the U.S. agriculture system, particularly in the western states such as Colorado and California and national economy.

<sup>xliiv-xv</sup>

The USDA Cause of Loss dataset shows that western states contained over 96% of U.S. cropland area lost to fire, with California (180.4 km<sup>2</sup>), Washington (13.7 km<sup>2</sup>), and Oregon (8.3 km<sup>2</sup>) reporting the highest net-determined crop acres lost to fire damage.<sup>xlii</sup> Figure 17 illustrates the cycle of wildfire impacts on agriculture. Fires generate particulate matter, increase ozone and cause downwind, downstream, and direct damage to crops and livestock.<sup>xliii</sup> These effects affect the health of livestock, agriculture workers, water, and the soil itself. Each of these independently or in combination

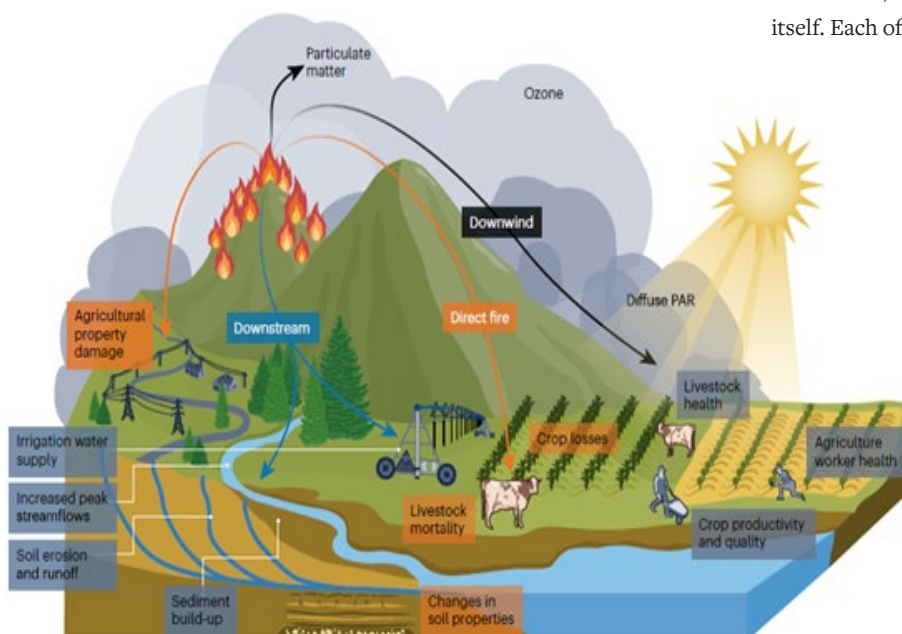


Figure 17. Pathways of wildfire impacts on agricultural systems<sup>xliii</sup>

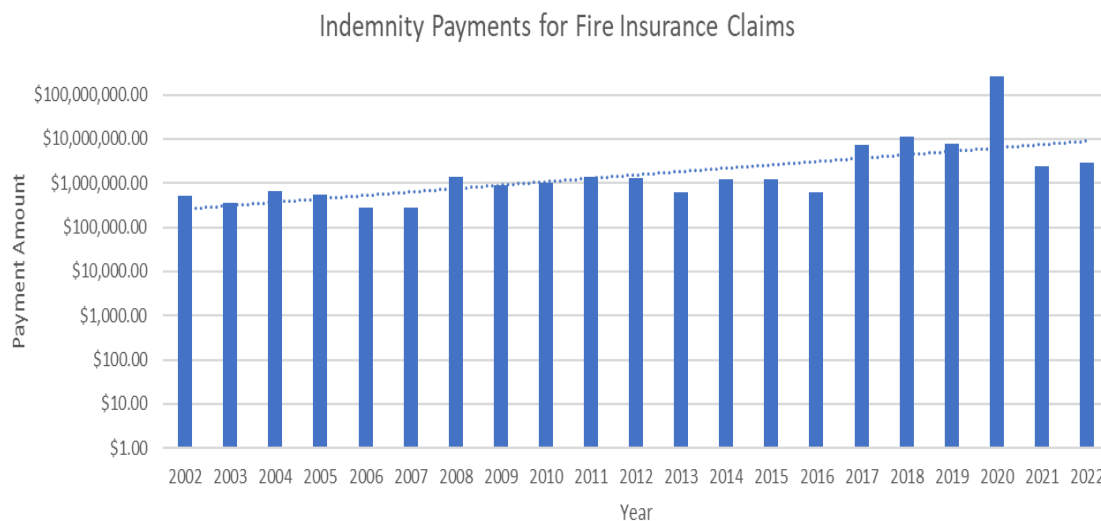


Figure 18. Indemnity Payments for Fire Insurance Claims<sup>xiii</sup>

can directly affect agricultural supply chains, which directly impacts independent restaurants. Furthermore, impaired health of agriculture workers can cause labor shortages, creating a backlog with high demand and low supply.

## Consequences for Independent Restaurants

Independent restaurants heavily rely on a well-functioning supply chain to procure essential ingredients and materials for their operations. When fire-related disruptions occur, the consequences can be dire. These disruptions not only affect the availability of ingredients but also lead to increased prices, reduced product quality, and delayed deliveries. As a result, independent restaurants face challenges in maintaining their usual standards, meeting customer expectations, and ensuring profitability.

Figure 18 reflects the amount of indemnity payments issued over the last 20 years due to fire-related insurance claims.<sup>xiii</sup> The number fluctuated throughout the years and rose significantly in 2020. These claims will continue to rise as climate change progresses, which points to the need for resilient supply chains.

## Summary of the Main Points

**Effects of Wildfires:** California, Washington, and Oregon experienced the highest net-determined crop

acres lost to wildfire damage. Wildfires in the western U.S. cause a myriad of environmental and health consequences, including but not limited to crop failure, damage to livestock, soil contamination, poor water quality, and health issues in agricultural workers. Approximately 2.5 to 3 million agricultural workers in the U.S. experience health issues and smoke exposure from a rise in wildfires around the country. Wildfires can also create lasting disruptions on supply chains, which can result in low ingredient availability, high prices, poor product quality, and slow deliveries.

## Conclusion

- **Environment and Health Consequences of Wildfires:** Wildfires produce particulate matter, which enters the environment, harming crops, and livestock. This in turn can affect the water and soil quality. Furthermore, due to their profession, agricultural workers are vulnerable to experiencing some of the health concerns that arise from exposure to wildfires.
- **Supply Chain Consequences of Wildfires:** Damaged crops or livestock can cause delays or a decreased amount of stock, resulting in a shortage in the supply chain, which would reduce crop availability and increase the prices for independent restaurants.



### 3.4 Impacts of Floods on the Food Supply Chain

Climate change is causing more intense extreme weather events and changes in precipitation patterns, which have made floods more common.<sup>xlvi</sup> Floods happen almost daily in the U.S. These range in severity,<sup>xlvii</sup> and impact the production of food on farms as well as restaurant operations. Floods also reduce crop yields that lead to economic losses for restaurants. Flood insurance is important for businesses, especially in flood-prone areas, to lessen the subsequent economic hardships. Nonetheless, flood insurance rates have become more expensive, especially in flood-prone states such as Florida and Louisiana. National Flood Insurance Program policies are expected to increase an average of 51% over the next 10 years, especially in riskier states.<sup>xlviii</sup> Since 2017, six flood insurance companies in Florida were liquidated<sup>xlix</sup> in 2022 alone, and 68,200 homeowners' policies were canceled by FedNat, leaving few options for homes and businesses operating in the state.<sup>l</sup>

The National Flood Insurance Program (NFIP) was created by Congress in 1968 and they are now billions of dollars in debt because of water damage, and how common floods have become. Insurance premiums are intended to cover payments for flood rebuilds, but

premiums are too low to cover the costs and flooding is too widespread. FEMA reports that just one inch of water can cost up to \$25,000 in damages.<sup>li</sup> If the house or business is located in a Special Flood Hazard Area (SFHA), insurance through NFIP is required but the enforcement is poor. Areas not deemed hazardous for floods can still be impacted by floods and experience water damage. As the sea level rises and precipitation patterns shift, more and more properties are becoming vulnerable to flooding. The Federal Emergency Management Agency (FEMA) report suggests an update to flood maps to better characterize risks<sup>lii</sup> and increased insurance to cover vulnerable properties. *Figure 19* shows hidden flood risks in the U.S. Almost the entire country is at risk of flooding.<sup>liii</sup>

The states with the highest average flood insurance rates are Connecticut, Hawaii, Massachusetts, New Jersey, and Rhode Island—but costs depend on whether the restaurant lies in a high-risk flood prone area. The states with the fastest growing insurance rates are Texas, Mississippi, Florida, Georgia, and Alabama.<sup>liii</sup> For independent restaurants who own their own property, the costs of flood insurance are a growing concern as well as a growing necessity.

Many farmers have crop insurance to protect them from various natural disasters and other environmental threats. Floods on farms may decrease

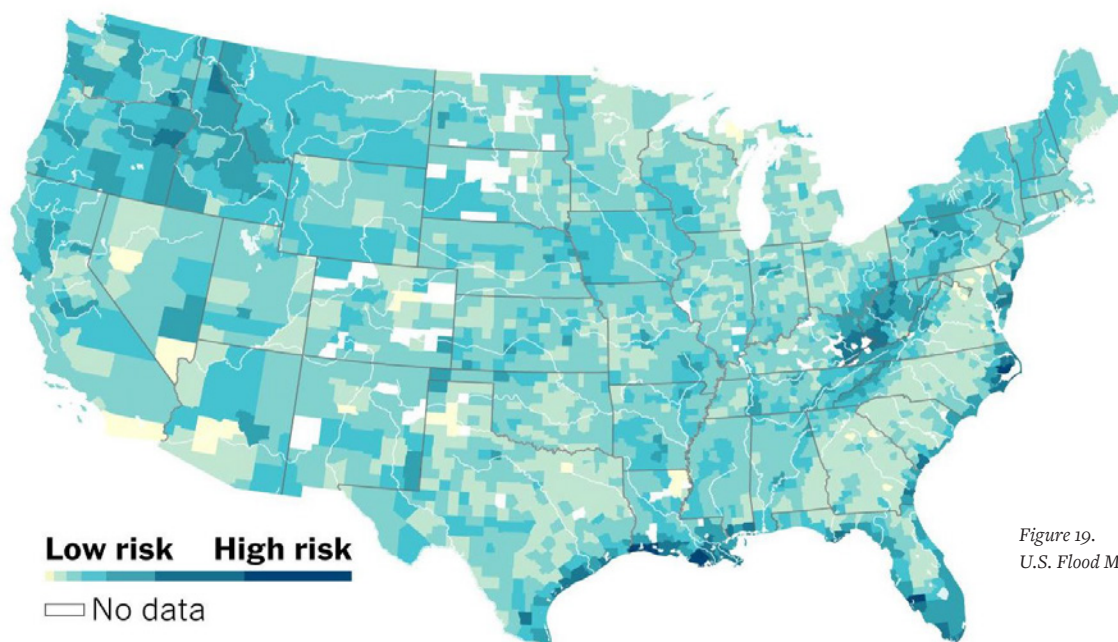


Figure 19.  
U.S. Flood Model <sup>ii</sup>

crop yields, ruin equipment, contaminate the crops and soil, and erode the soil. The historical cause of loss data was used from the USDA risk management agency to seek trends due to flood losses.<sup>xiii</sup> As shown in *Figures 20 and 21*,<sup>xii</sup> total indemnity payments and claims due to losses from “excessive moisture/precipitation/rain” were evaluated from 2003 to 2022.

These data show that flooding and other “extreme moisture” is a major cause of loss for farmers and impacts food production and in turn, the food supply chain. These flood events cause ripple effects that impact independent restaurants negatively.

For example, 2019 was a particularly bad year for crop loss due to excess moisture and floods. Hurricane Barry hit the gulf coast, and although it was only a category 1 hurricane, caused a large amount of damage to property due to storm surge and flooding.<sup>iv</sup> Texas had 2,853 insurance claims due to excess moisture, and Louisiana had 1,330 claims.

Flood insurance is also becoming more expensive to try to keep up with the increasing damage that floods cause. Many flood insurance companies have been liquidated recently, especially in flood prone areas. The price of insurance depends on how vulnerable the business is to flooding, but new data show that more and more areas are becoming susceptible to flood damage. Between disruptions in service due to local flooding, independent restaurant also have to be concerned about the flooding in other parts of the country and world which will disrupt their food supply chain.

### 3.5 Impacts of Power Outages on the Food Supply Chain

Climate change is causing more intense storms, which will lead to more power outages. This problem is exacerbated by our aging power grid. Extreme weather is the most common cause of a power outage.<sup>vi</sup> The U.S. Department of Energy reports that weather-related power outages have increased by 67% since the year 2000.<sup>lvi</sup> Not only are power outages and blackouts becoming more common and lasting longer, and they are also happening more often in vulnerable areas.

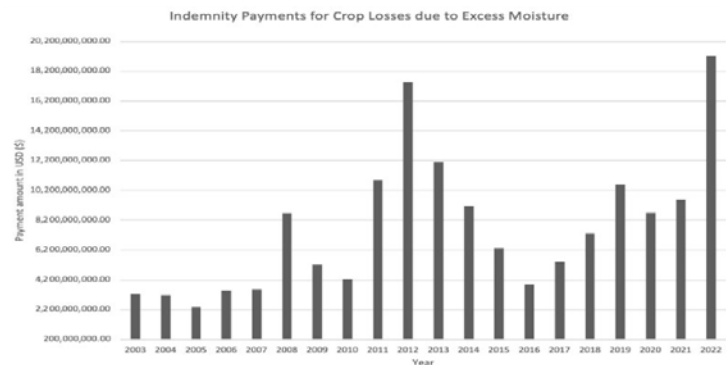


Figure 20. U.S. Indemnity Payments due to Excess Moisture<sup>xlii</sup>

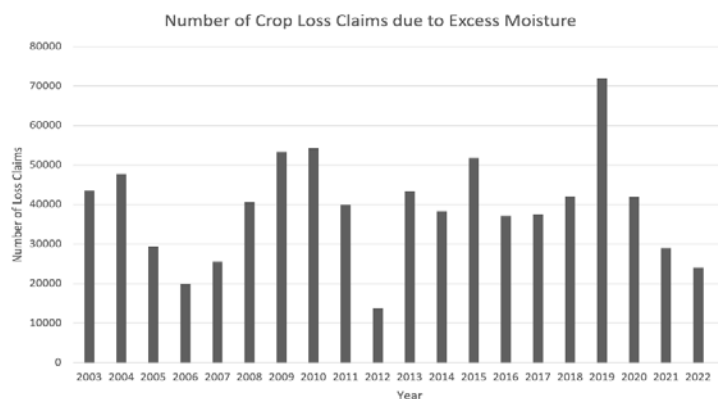


Figure 21. Number of U.S. Crops Loss Due to Excess Moisture<sup>xlii</sup>

In restaurants, power outages can cause food spoilage,<sup>lvii</sup> disrupt Point of Service (POS) systems—the electronic checkout/cashier systems for restaurants— electric cooking and preparation tools, and reduced availability of ingredients due to supply chain disruptions.

Perishable food must be disposed of properly following a significant loss of power event. Recent data from the U.S. Energy Information Administration (*Figure 22*) shows that the average duration of a power outage has grown from 3.5 hours to 7 hours between 2013 and 2021.<sup>lviii</sup> The frequency of power outages has also increased in the same time period, from 1.2 to 1.42 outages per customer.<sup>lviii</sup> These disruptions puts an added burden on restaurateurs to purchase additional insurance to cover food spoilage, utility disruption, and even income loss.

## Summary of Main Points

**Effect of Floods:** Floods are prevalent within the U.S., occurring nearly daily with varying degrees of severity.

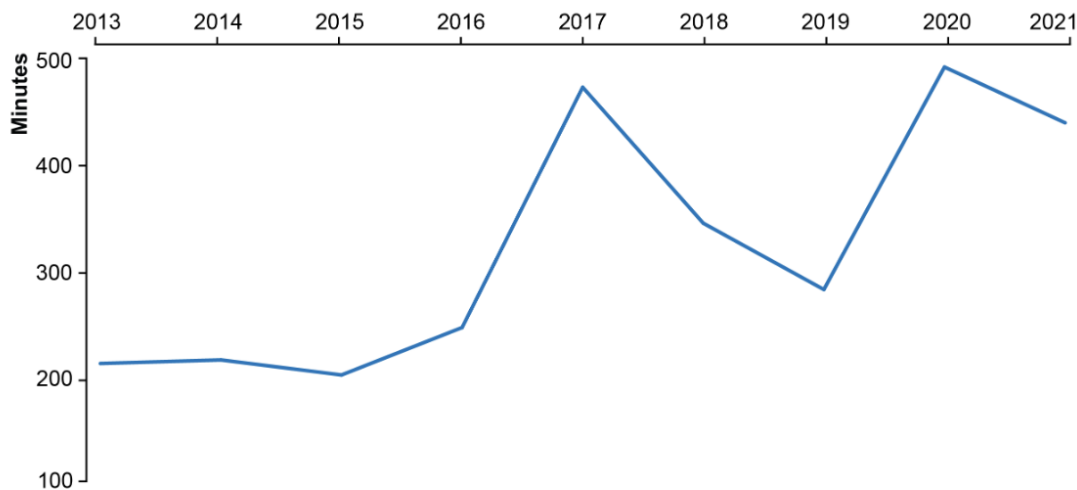


Figure 22. Duration of Power Interruptions. Number of minutes of non-momentary electrical interruptions a customer experience on average <sup>lviii</sup>

As the sea level rises and precipitation increases, a greater number of properties are becoming vulnerable to flooding. Flooding and other “extreme moisture” events are a common cause of crop loss, halting food production and thus, the food supply chain. Flood events cause ripple effects on the supply chain that negatively affect independent restaurants. Lower crop yields can result in increased prices for restaurants purchasing the crops.

**Flood Insurance:** Having flood insurance is a must for businesses when alleviating the economic hardships caused by floods. Flood insurance rates have grown costly, particularly in flood-prone areas like Florida and Louisiana. With high rates of flooding, water damage has become expensive to repair, with one inch of water costing up to \$25,000 in damages. The National Flood Insurance Program itself is in debt by the billions due to the high price of water damage repairs. Insurance premiums should cover payments for flood rebuilds, but they’re too low to cover costs. The price of water damage repair is expected to continue increasing by an average of 51% over the next 10 years, or even more in risky areas.

#### **Effect of Weather-related Power Outages:**

Weather-related power outages have risen by 67% since 2000. <sup>lviii</sup> The average span of a power outage has increased from 3.5 hours to 7 hours from 2013 to 2021. <sup>lviii</sup> In the event of a loss of power event, perishable food must be properly discarded. Restaurants may suffer from food spoilage, and be

unable to use their POS systems, electric cooking, and preparation tools when experiencing a power outage. As power outages become more common, more food will likely be wasted if a power outage occurs in a restaurant. Disposing of food or shutting down due to lack of electricity will cause a decrease in revenue for restaurants.

## **Conclusions**

### **— Supply Chain Consequences of Floods:**

Flooding results in crop loss, temporarily stopping production altogether. This can create a blockage in the supply chain. Low crop supply can translate to skyrocketed prices for restaurants hoping to buy the crops.

### **— Significance of Flood Insurance:** Despite flood insurance costs increasing rapidly, the high prevalence of floods highlights the necessity of investing in flood insurance.

### **— Restaurant Consequences of Weather-related Power Outages:** In the event of a power outage, restaurants may face a loss of revenue, if forced to dispose of their food due to food spoilage. Restaurants cannot continue many of their operations without electricity, such as POS systems, and electric cooking, so they may have to shut down during the power outage, resulting in loss of income.

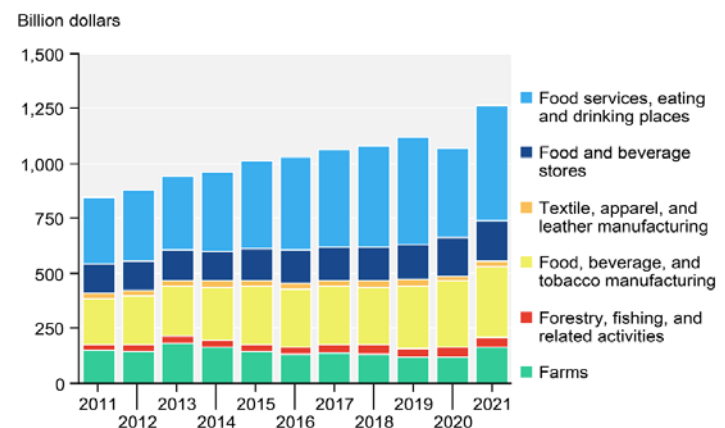
# Bring it Back Home

## 4.1 U.S. Agriculture

The impact of agriculture extends far beyond the farming industry and includes sectors such as food service and food manufacturing. The U.S. hosts over two million farms, and more than half the nation's land is used for agricultural production,<sup>xiv</sup> yet the number of farms has been slowly declining since the 1930s. However, the agriculture industry continues to contribute more than \$1.1 trillion to the U.S. GDP and 10.9 percent of total U.S. employment—more than 22 million jobs.<sup>xviii</sup> Food service alone makes up the largest share of these jobs at 11.8 million.<sup>xiv</sup> The agricultural sector influences success rates of independent restaurants by affecting the availability of food products at local, national, and global scales.

Spanning the last 20 years, U.S. consumers and supply chains alike have experienced shifting and evolving trends across the greater food industry. The nation has seen certain sectors rising in interest, with others falling. The meat, beef, and poultry processing industries, for example, have seen steady increases in production, revenue, and profit, growing their market value to almost \$300 billion annually as of 2023.<sup>xxi</sup> Other sectors, such as fruit and nut farming, have struggled to maintain steady revenue streams. Total revenues have seen a steady decline since 2014 when annual revenues averaged roughly \$34 billion, to an average of around \$23 billion in 2023.<sup>lx</sup> A significant demand for the availability of fresh fruits and vegetable indicates a shift to a healthier lifestyle. Despite these contrasting shifts, the total food industry overall is growing. As early as 2011, the total value for the U.S. food industry was about \$875 billion. In 2021, that number now exceeds \$1.25 trillion (*Figure 23*).<sup>xiv</sup> U.S. food service sales were approximately \$250 billion in 2011, and in 2021 grew to almost \$500 billion.<sup>xiv</sup> Both consumer preferences and availability drive changes both on farms and in restaurants.

**Value added to U.S. GDP by agriculture and related industries, 2011–21**



Note: GDP = Gross domestic product.  
Source: USDA, Economic Research Service using data from U.S. Department of Commerce, Bureau of Economic Analysis, Value Added by Industry, as of December 22, 2022.

Figure 23. Value added to the U.S. GDP by Agriculture <sup>xviii</sup>

## 4.2 Defining Local

The scope of “local” changes depending upon context. Within the agriculture and food service industries, there are a wide array of definitions. In the scope of research pertaining to supply chains and climate change, it makes sense to be more liberal with our estimates of “local,” acknowledging the vastness of ecological and geographical regions of the U.S. Our use of “local” will be consistent with the USDA’s definition,<sup>lxi</sup> describing local food as “400 miles from the origin of the product, or within the state in which the product is produced.”

The importance of local food in the U.S. has been increasing over the years. Agricultural surveys have found that local sales are increasing, with farms selling “almost \$10.7 billion<sup>lxii</sup> of edible food commodities directly to consumer outlets and intermediary supply chains, such as restaurant/grocery stores, regional distributors and local institutions—a nearly \$2.8 billion (35%) increase from 2019.”<sup>lxii</sup>

## 4.3 Infrastructure of Food: The Role of Food Hubs

With the rise of globalization, the 20th century saw the burgeoning of the food supply chain into a dynamic and multifaceted global system. While this remains so today, the 21st century is witnessing a trend back towards small-scale productions and distribution. Many of the local and regional supply chains are run through farmers markets, farm stores, Community Supported Agriculture (CSAs) and food hubs. These venues are particularly important for low-income farms (*Figure 24*).

A food hub is a business or organization that aggregates, distributes, and markets locally produced food. Food hubs can provide restaurants with a convenient and reliable way to access a wide variety

of local products, including produce, meat, dairy, and eggs. As noted by the Sustainable Agriculture Research and Education Program, there has been a significant increase in the proliferation of food hubs across the U.S.<sup>lxiii</sup> Between 2007 and 2014, the number of regional food hubs surged by an impressive 288%. By 2017, the U.S. boasted the presence of almost 400 identified food hubs.<sup>lxiii</sup>

Many of these food hubs work directly with restaurants to supply them with local food. For example, the Arcadia Mobile Market introduced itself as a food hub in 2012,<sup>lxiv</sup> featuring a traveling farm stand stocked with a variety of locally and sustainably produced foods. These offerings include fresh fruits, vegetables, herbs, pastured eggs, grassfed and pastured beef, pork, organic milk, cheese, artisanal bread, and honey. Since its inception in 2012, the Arcadia Mobile Market has successfully distributed over \$1.4 million worth of reasonably priced, top-quality, locally sourced fresh food within underserved communities in Washington, D.C.<sup>lxiv</sup> Nonetheless, the mobile market is not self-sufficient and continues to rely on grant support.<sup>lxiv</sup>

Another way that local restaurants rely on local food farms is through direct relationships with farmers. Many restaurants develop close relationships with local farmers, who they can rely on to provide fresh, high-quality produce and other ingredients. These relationships can also benefit farmers, who can sell their products directly to restaurants at a fair price. Restaurants in the U.S. are interested in sourcing more local food. This interest is driven by a number of factors, including customer demand, a desire to support the local economy, and a commitment to sustainability.<sup>lxv</sup>

The presence of local supply chains is not evenly distributed across the nation. As shown in *Figure 25*,<sup>lxv</sup> higher concentrations of farms that conduct intermediate sales appear in darker blue, while food hubs are marked as red dots. Food hubs and farms with intermediate sales are concentrated in the New England region as well as along the West Coast. This uneven distribution is still reflected today.<sup>lxv</sup> The top five states by value of total direct-to-consumer sales (2022) are:

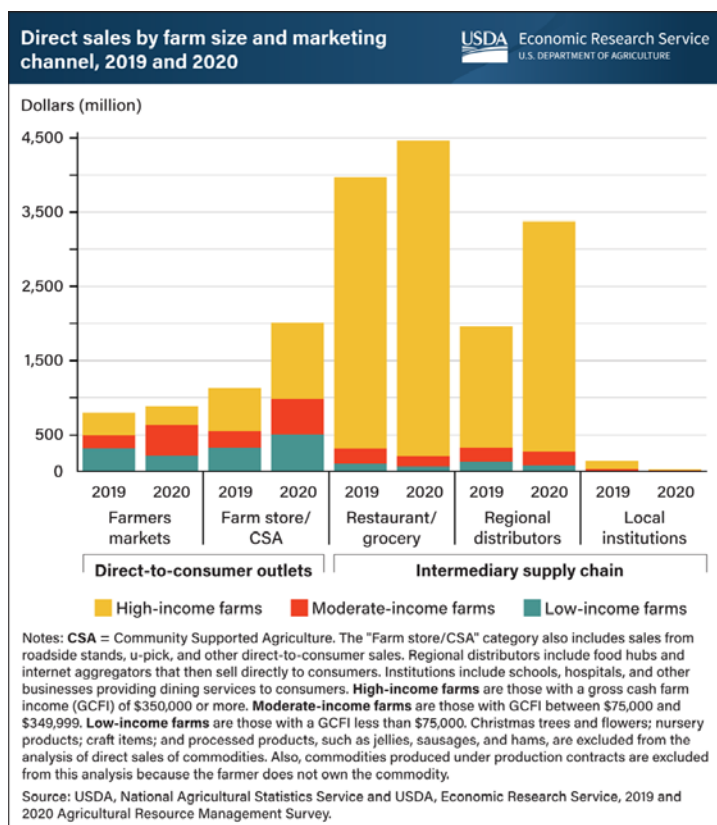
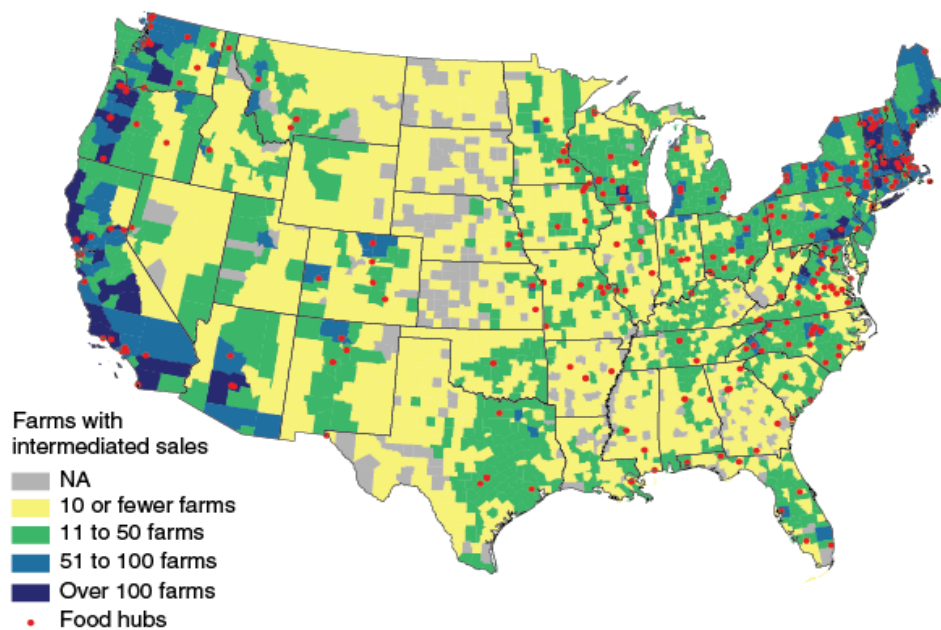


Figure 24. High, moderate, and low-income farms monetary impact <sup>lxvii</sup>





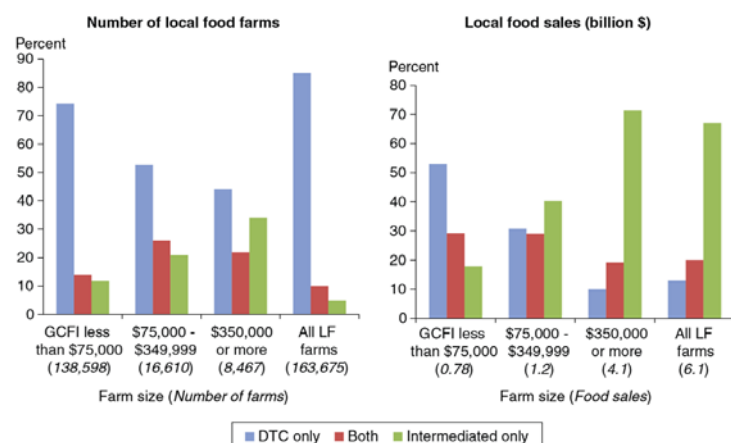
Source: USDA, Economic Research Service using data from the 2012 Census of Agriculture; USDA, Agricultural Marketing Service, 2014.

Figure 25. Farms with intermediated sales (2012) and food hubs (2014) <sup>xv</sup>

1. California, \$1.4 billion
2. Pennsylvania, \$600 million
3. New York, \$584 million
4. Michigan, \$555 million
5. Maine, \$342 million

Local food producers play a significant role in selling their products directly to consumers (Figure 26), markets, and institutions, making up 76% of their total agricultural product sales.<sup>xv</sup> Notably, those with more experience in farming and direct marketing tend to have higher shares of local food sales. Financially, less experienced farmers tend to have positive net farm sales more often. In particular, 83% of first-year farmers achieved positive net sales, followed by 73% of inexperienced farmers and 70% of experienced ones.<sup>lxii</sup> Internet use for buying farm inputs and accessing market info seemed to be linked to positive net farm sales. As of 2015, approximately 71.2% of farmers that produced local foods had annual sales valued at \$1–49,999. Annual sales for local food averaging between \$50,000–249,999 account for 20.9% of farms in the U.S. The remaining 7.9% of farms make greater than \$249,999 annually for local food production, creating a local food industry worth an estimated \$12 billion.<sup>xix</sup>

The West Coast of the U.S. has been a hub for the local and sustainable food movement. States like California, Oregon, and Washington have a climate conducive to year-round agriculture, and the region has a strong focus on organic and sustainable farming practices. Restaurants on the West Coast often have access to a wide variety of locally grown produce, making it easier



Note: The share of farms by farm size and marketing channel use are based on 2012 Census benchmark counts; the shares of total value of local food sales by farm size and marketing channel use are synthetic estimates. DTC = direct-to-consumer; GCFI = Gross cash farm income. Source: USDA, ERS/NASS, ARMS data, 2008–2011; USDA, NASS, 2012 Census of Agriculture.

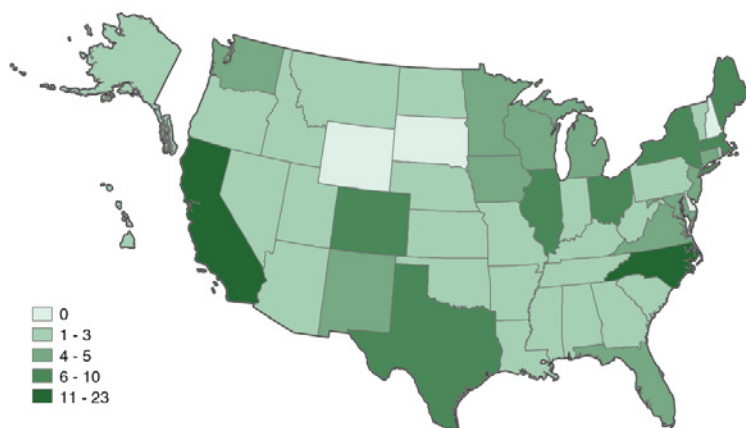
Figure 26. Local food farms and sales by farm size and market channel use <sup>xv</sup>

to source local ingredients. Additionally, West Coast consumers tend to be more aware of and supportive of locally sourced foods, which can benefit restaurants in their marketing efforts.<sup>xv</sup>

Most food hubs and local farmers are found along the West Coast supporting a robust supply chain for local restaurants. Furthermore, the West Coast community is more civically engaged with their local food supply chains. California not only produces the largest number of agricultural products in the U.S., but it also boasts the highest number of food councils that engage and support the local food movement (Figure 27).<sup>xv</sup>

## Summary of the Main Points

**Economic Impact of Agriculture Industry:** The agriculture industry is a critical sector of the U.S. economy, contributing over \$1.1 trillion to the U.S. gross domestic product. It accounts for 10.9% of total U.S. employment, employing 22 million people, with 13 million of them in the food service industry. Overall, the U.S. food industry has been growing overtime. From 2011 to 2021, the U.S. food industry's value increased from \$875 billion to \$1.25 trillion. During that time period, U.S. food services doubled, reaching \$500 billion in 2021.



Note: Data exclude Native American tribal councils.  
Source: Johns Hopkins Center for a Livable Future, 2014.

Figure 27. State, regional, and/or local food policy councils, 2013<sup>xv</sup>

**Rising Local Sourcing Trends:** The emphasis of sourcing locally in the U.S. has been increasing overtime. Consumers surveyed in the 2016 Restaurant Industry Forecast asserted that they are searching for restaurants who source and serve local food. Agricultural surveys highlight the uptick in local sales, with farmers directly selling nearly \$10.7 billion of edible food commodities—a \$2.8 billion increase from 2019. The push to source locally can also be seen in the upsurge of food hubs over the past decade, which act as a central location for restaurants to purchase a variety of local food. Local food hubs also provide local farmers with a space to sell their product, with sales at these hubs composing 76% of local farmers' total agricultural product sales.

## Conclusion

- **Economic Significance:** The agriculture industry is a key component of the U.S. economy, generating steady revenue and employment. Over half of the nation's land is used for agricultural production.
- **U.S. Food Industry Trends:** The U.S. food industry has been growing as a whole, although certain sectors within the industry have gained interest, while others have performed poorly. For example, the meat, beef and poultry processing industry has steadily increased in production, revenue, and profit, whereas the fruit and nut farming sector have experienced difficulty maintaining revenue streams.
- **Interest in Local Food:** Consumers have expressed their desire for locally sourced foods, which has prompted an increase in the sale of locally sourced food from farmers. The local and sustainable food movement is more prevalent on the West Coast.
- **The Role of Food Hubs:** Food hubs serve as a mutually beneficial space for local farmers and restaurants, where local farmers are able to directly sell their crops, and restaurants are able to purchase local food to meet the needs of consumers.



# Change or the Climate Will

## 5.1 Fate of the System

The agriculture sector is one of the most climate-vulnerable sectors, faced with the consequences of increasingly frequent and extreme weather events.<sup>xxiii, lxvii-lxviii</sup> Climate change affects every level of food security from local to global. Disruptions are characterized by projected temperature increase, changing precipitation patterns, extreme weather events, and reductions in water availability.<sup>xiv, lxix</sup> As the effects of climate change increase, the food systems that independent restaurants depend on are increasingly threatened. Their future, and that of their owners, are at risk. Climate change will “disrupt food availability, reduce access to food, and affect food quality”<sup>xiii</sup> as extreme weather events such as droughts and floods change the landscape of modern agriculture. Changes in annual temperatures and conditions are forcing farmers to adopt new strategies and new crops to grow and sell,<sup>xiv</sup> altering local and regional supply chains. The environmental impacts become economic shocks through these events, which are then propagated in the supply chain,<sup>xv</sup> leading to increased costs for produce and meats, and higher prices for consumers.

## 5.2 Effects of Climate Change on Crop Yields

The climate impacts of food production extend to disruptions in the supply chain. As discussed, major supply chain disruptions have been caused by droughts, heatwaves, wildfires, and floods.<sup>xiv, lxvii, lxviii, lxx</sup> These climate disruptions have ripple effects on the food industry through price fluctuations, interruptions in food delivery, increased temperatures leading to spoilage and contamination, and potentially exacerbating food security challenges.<sup>lviii, lxx-lxxi</sup> Due

to the national and global interest in the agricultural sector, research has focused on farms, as temperatures fluctuate and growing conditions change with the changing climate.<sup>lxxii</sup> Climate change is not affecting all locations the same.<sup>lxxiii</sup> Regarding U.S. agriculture, these differences suggest that our responses must be adaptable and agile.<sup>lxxiii</sup>

Over one-third of U.S. vegetables and three-fourths of the country’s fruits and nuts are grown in the state of California.<sup>lxxiv</sup> Rising annual temperatures, which have already increased by approximately 1°C in some parts of the state,<sup>lxxv</sup> and earlier spring warming means less “winter-chill” hours for trees, a necessary biological component needed to start the process of flowering. By mid-century, the daily maximum temperature average is expected to rise 2.5–3.3°C.<sup>lxxv</sup> Projections, suggest that within the next few decades, conditions will “no longer support some of the main tree crops currently grown in California.”<sup>lxxv</sup> Within the Central Valley region, conditions for growing walnuts, pistachios, peaches, apricots, plums, and cherries will significantly decline throughout the century, while safe locations for the growth of apples, cherries and pears might be gone by mid-century.

The decreased yields or total loss of fruit trees can impact the market for several years because lost productivity cannot be made up for by planting new trees. Some fruits take a range of 3–5 years<sup>lxxvi</sup> (cherries and plums) or 4–6 years (apples and pears) to begin producing fruit, pointing to the long term repercussions of global warming.

While rising greenhouse gas (GHGs) levels might be beneficial to the growth of pastureland by increasing their productivity, they diminish the nutritional value of that land, which means that livestock will require more grass across more land. Events like drought<sup>lxxvii</sup> could have a double impact on meat and

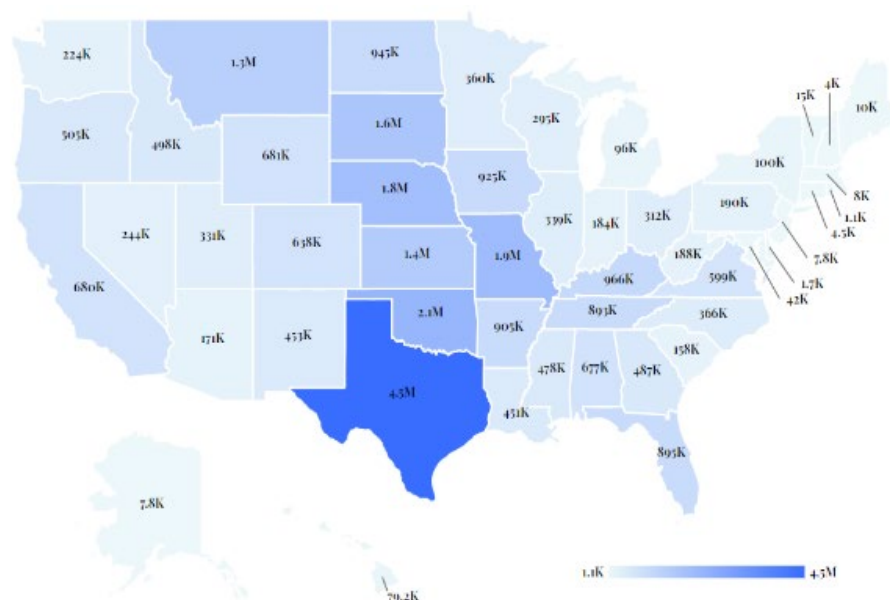


Figure 28. Beef Production by State from *wisevoter.com*<sup>xcii</sup>

dairy production, because it dries up pastureland and decreases the nutritional intake of the livestock, leading to a larger dependence upon the feed grains that may be similarly affected by such changes. The complex relationship between rising GHGs, climate-related events like drought, changes in pastureland productivity, and their collective impact on livestock production, will result in economic repercussions for the agricultural sector.

While most of the meat industry's vulnerabilities lie in its processing and distribution, severe weather has an impact on feed crops, corn yields could decrease by 24% by 2020,<sup>lxxviii</sup> increasing the price of feed with costs that will be passed on to restaurants and diminish the capacity for meat and dairy farms to support their livestock. Increased temperatures can also lead to heat stress in cattle, increasing their "vulnerability to disease, reduce fertility, and reduced milk production."<sup>lxxix</sup> These impacts are already taking place in Texas, the largest producer of cattle in the U.S. (Figure 28).<sup>lxxx</sup> An extended dry period in Eastern Texas led ranchers to sell 2.7 million cattle between January 2022 and August 2022,<sup>lxxix</sup> an 18% increase from the year before, because ranchers were unable to sustain the increased need of water and feed necessary for their herds. 2022 was not an anomaly as described in the impacts of the 2011 Texas drought. Figure 28

compares states producing cattle by number and projected rises in temperature by mid-century, with Texas projected to rise 1.5°C and over 2°C in central states.<sup>xcii</sup>

Extreme temperatures in the Corn Belt have affected corn yields, while the warmer Michigan winter caused premature budding of cherry trees resulting in \$220 million dollars in losses.<sup>lxxvii</sup> The 2012 drought impacted Illinois, Indiana, Minnesota, and Nebraska as there was a 55% variation in corn yields across the region.<sup>lxix</sup>

Paul Ekins, a Professor of Resource Environmental Policy at University College London, articulates that despite the enhancement in crop yield per hectare over the last five decades, the past 15 years have witnessed some fluctuations. He emphasized that 30% of the observed variations in crop yields can be attributed to climate-induced factors, particularly evident in specific crops like barley, maize, millet, pulses, and rice.<sup>lxx</sup> This blend of climate change effects, fluctuating crop yields, and global agricultural production trends underscores the complex interplay between climate change and the food supply chain. Future projections loom large over the potential severity of climate change as depicted in figure 29.<sup>lxxxi</sup>

## Climate Change and Imports

Climate change has also had an impact on imported products, such as chocolate, coffee, and many wines. Decreasing yields, increased pest and fungus infestations,<sup>lxxxii</sup> and a shrinking amount of arable land<sup>lxxxiii</sup> for wine grapes,<sup>lxxxiv</sup> cocoa beans, and coffee beans increase costs for the market-level restaurants and consumers who depend on them. Even table condiments, such as mustard,<sup>lxxxv</sup> have been impacted; a 2021 drought in Canada reduced production by half and a subsequent drought in France damaged more mustard seed supply. As a result of these droughts and issues in the packaging supply chain, prices rose between 15 and 75% in 2022 alone,<sup>lxxxvi</sup> with the exact increase depending upon the kind of mustard harvested and packing materials used.

## Climate Change and Sugar

Mexico, the major sugar export partner for the U.S., saw lower yields in 2019<sup>lxxxvii</sup> because of widespread drought conditions affecting the harvest season. Furthermore, unseasonal rains prevented harvesters from working in the fields which led to a delayed harvest and lower yields. The diminished sugar supply in the Mexican market resulted in the country's inability to meet the export demands of the U.S., resulting in shortage of 200,000 tons.<sup>lxxxviii</sup> Furthermore, in 2019, poor weather in Sinaloa,<sup>lxxxix</sup> Mexico's leading tomato-producing state, combined with the Covid-19 pandemic's impact on the supply chains, led to a slight decrease in anticipated tomato production and trade. Despite this, central Mexico's spring/summer supplies met U.S. demand for the rest of the marketing year.

## Climate Change and Rice

With respect to restaurants, particular cuisines will be affected differently by production issues. For example, each 1°C increase in temperature, will decrease rice yields by 14%<sup>rice</sup> growing regions of the southeastern U.S. and up to 40% globally<sup>xi</sup> will be affected by the end of this century. Decreased yields will increase costs for restaurants that prepare rice-based dishes. Decreased production of durum wheat, used in most pastas, has also occurred. In Canada yields decreased from 6.5 million metric tons in

2020<sup>xii</sup> to an estimated 4 million metric tons in 2023. Pasta prices have increased throughout the past few years, with suppliers in Europe doubling prices. The Supply Management Commodities Index reported a 63% price increase<sup>xiii</sup> of wheat between 2020 and 2021.

## Climate Change and Spices

Production of many kinds of spices, which are often grown in small pockets of the planet that meet the spice's ideal growing conditions, has also decreased in response to climate change. India produced almost 11 million tons in 2021-2022 according to the India Brand Equity Foundation,<sup>xiv</sup> accounting for more than one-third<sup>xv</sup> of total spice production. The market is projected to reach a \$22.4 billion USD market by 2028.<sup>xvi</sup> India is a geographically diverse country and is already impacted by climate change, with extreme rainfall or flooding events in 75% in central regions<sup>xvii</sup> despite an overall decrease in annual rainfall, and an increase in temperature averaging 0.7°C.<sup>xviii</sup>

A case study in the state of Kerala<sup>xix</sup> connected climate change-related "devastating floods" to a decrease in production of black pepper, cardamom, nutmeg, clove, ginger, and turmeric equaling 25,000 metric tons in the 2018-2019 year alone. This case only covers one area at one point in time but serves as a valuable snapshot into how the production of these

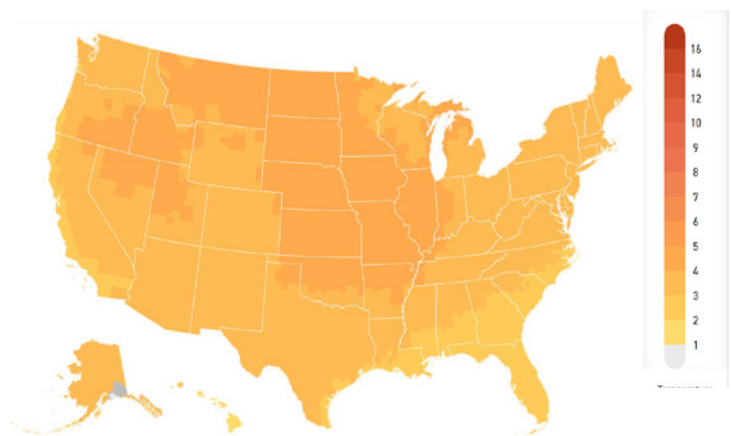


Figure 29. Projected heat increases by mid-century (2040-2059) <sup>xxii</sup>

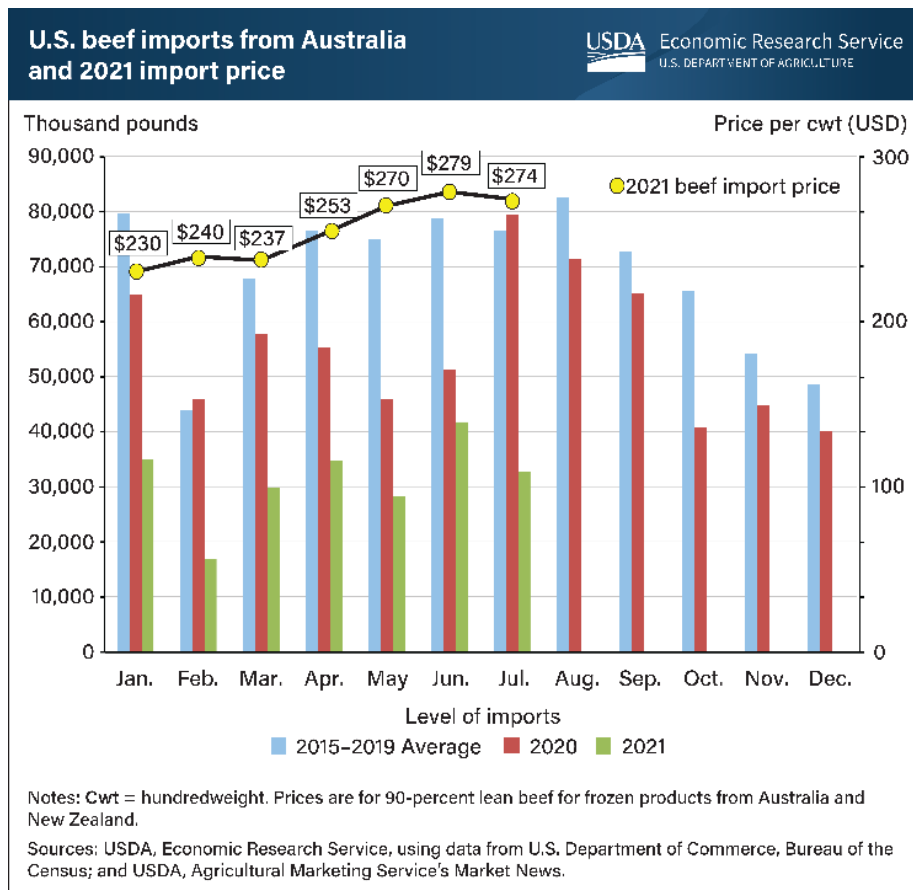


Figure 30. Change to beef imports Australia to other imports<sup>ci</sup>

crops is vulnerable to the erratic weather coming from climate change. The projected increase in demand and production in the Indian spice market, combined with the projections for how climate change will be affecting India's landscapes,<sup>c</sup> imply market fluctuations in the future.

## Climate Change and Beef

In 2021, following a two-year drought, Australia, which is the primary supplier of processing-grade beef to the U.S., saw its suppliers reduce slaughter, limiting the amount of beef available for export and raising the prices of those exports. However, imports from Brazil, New Zealand and other nations somewhat compensated for the decline in imports from Australia.<sup>cii</sup>

Figure 30 illustrates the rise in prices of Australian beef in 2021 and the corresponding decrease in U.S. imports, attributed to a two-year drought.<sup>ci</sup> In January,

which recorded an average import of 80,000 pounds from 2015 to 2019, there was a decrease to 35,000 pounds in 2021. This reduction remained consistent throughout the months of 2021 compared to the previous years and was paralleled by a price increase. In February 2021, imports from Australia were priced at \$240 per hundredweight (cwt) for 90 percent lean beef, and the volume decreased to just under 17 million pounds, which is almost 27 million pounds less than the five-year average. By July 2021, this price had increased to \$274 per cwt.

## Climate Change and Soft Commodities

Commodities such as coffee and wheat experienced significant price fluctuations in 2021 as production was impacted by extreme weather conditions attributed to climate change. Brazil, the world's largest coffee producer and a major corn supplier, faced a severe

drought in April 2021, leading to a brief spike in prices. Concurrently, southwestern Canada and the northern plains of the U.S. underwent a prolonged springtime drought, damaging their wheat production for the year. This situation drove wheat prices to near-historic highs of \$300 per ton.<sup>lxxvii</sup> The changing weather patterns, made worse by climate change and Amazon deforestation, are increasing the frequency of extreme weather events, presenting a bleak outlook for soft commodity growers. The global market's dependency on specific regions for certain crops, like arabica coffee in Brazil, is also amplifying market fluctuations.<sup>ciii</sup>

Food Production Cost Increases <sup>xlvi</sup>	
Fertilizers	35% increase
Crop Protection Products	25% increase
Fuel	48% increase
Plastic & Drip Tape	35% increase

Table 3. Food Production Cost Increase<sup>xxiii</sup>

Due to supply chain production and distribution challenges, the costs of production have skyrocketed without returning to normal levels (Table 3.)

Fertilizers, seeds, and farming equipment costs have kept both small and large food manufacturers from achieving pre-pandemic outputs. These conditions have farmers paying retail, selling wholesale, and paying all shipping and input costs on their products.

<sup>xxiii</sup> Cost increases are not limited to crop loss but are apparent throughout the entire supply chain, from production to final delivery.<sup>xxii-xxv</sup>

## Summary of Main Points

### Threats to Production—Rising Annual

**Temperatures:** Increases in temperature are a major threat to crop production. California supplies over  $\frac{1}{3}$  of the U.S.'s vegetables and  $\frac{3}{4}$  of its fruits and nuts, but the agriculture industry in the state is vulnerable to rising annual temperatures, which have increased by approximately  $1^{\circ}\text{C}$  in some parts of the state. Estimates indicate that by 2050, the daily maximum temperature average will rise  $2.5\text{--}3.3^{\circ}\text{C}$ . Due to this projected increase, over the next few decades, California will not be able to grow some of its main tree crops, such as apples, cherries, and pears. High temperatures across the Corn Belt have resulted in lower corn yields as well.

**Threats to Production—Drought:** Drought is another significant threat to crop production. In Canada, a 2021 drought reduced mustard seed production by half. France faced a drought soon thereafter, which resulted in a 15–75% mustard price increase in 2022. Similarly, due to an extensive drought, Mexico experienced lower sugar yields. Variation in rain pattern prevented harvesters from working in the field during certain periods, resulting in a delayed harvesting period as well. Due to the drought, Mexico was unable to meet the import demands of the U.S.

## Conclusion

- **Economic Significance:** The reduction in crop production due to climate events is driving up prices throughout the supply chain.
- **Food Implications:** According to projected trends, as climate change progresses, global supply chain issues will worsen significantly in the coming decades.

## 5.3 Transportation, Processing, and Distribution

Large-scale food production and the extensive transport of food are essential for sustaining the population of the U.S., but these processes are not free from consequences. Eighty-three percent of GHG emissions occur during the production phase. Transportation accounts for only 11% of life cycle GHG emissions, and the final delivery — or producer to retailer portion—makes up 4% of life cycle GHG emissions.<sup>xxii</sup>

Cereals and red meat constitute 14% and 13% of freight requirements, respectively. Fruits and vegetables account for 10% of the freight total, while dairy products, meat products other than red meat, nonalcoholic beverages, fats/sweets/condiments, and other processed food products (including frozen food) account for approximately 6-8% each.<sup>xxiii</sup> Distance among these freights varies considerably by category. Distance ranges from 330 km (205 mi) on average — or a total supply chain movement of 1,200 km (746 mi) for beverages to 1800 km (1118 mi) on average — with a life-cycle total of 20,400 km (12,676 mi) for red meat. In contrast, red meat has a low proportion of final delivery transportation requirements (9%), while fruits and vegetables have a higher proportion (50%), meaning that the supply chain for red meat is much more complex than that of fruits and vegetables. This reliance on delivery for fruits and vegetables results in comparatively higher CO<sub>2</sub> emissions and a larger share of transport GHG emissions.<sup>xxii</sup>

Understanding the transportation dynamics of various food categories and is crucial for several reasons:

- It helps identify which food categories contribute significantly to the overall freight requirements and associated environmental impacts.
- Knowledge of these transportation patterns can inform sustainable transportation and supply chain strategies to minimize greenhouse gas emissions and environmental footprints.

- Recognizing the complexity and distances involved in supply chains allows for targeted efforts to optimize planning and reduce transportation-related costs, energy usage, and environmental damage.

The greatest vulnerabilities within the processing and distribution components of the food supply chain can largely be attributed to extreme events and the processing and distribution infrastructure that is unable to cope with them. Extreme events such as droughts have revealed the delicacy of food distribution systems, like the 2012–2013 drought and flood in Mississippi<sup>cii</sup> that temporarily rendered the Mississippi river impassable in some areas and caused major merge traffic and transport disruptions. Another drought similarly affected the Mississippi river transportation system in 2022,<sup>cii</sup> backing up more than 2,000 barges.

These effects can increase global market prices, posing a threat to restaurants and consumers. Like current water flows in the Mississippi river, years of drought in Brazil have affected the source of the Parana River, which also serves as Argentina's main export channel for their grains. Low water levels have required ships to decrease their cargo storage by 18% to 25%, reducing exports.<sup>ciii</sup>

The ongoing drought in Panama in the summer of 2023 provides another example with direct consequences for the U.S., the major source for and recipient of shipments through the Panama Canal. The drought has caused low water levels in the canal, limiting the amount of traffic. Wait times for the canal have increased from several days to several weeks<sup>civ-cv</sup> and some shipping companies have begun charging fees<sup>cvi</sup> to compensate for lost profits. Transport delays also raise concerns about the effects of spoilage, in consumer health.<sup>cvi</sup>

Delays are not limited to water-borne transportation; “land, water, and air transportation are all vulnerable to climate change.”<sup>cvi</sup> Extreme weather events and adverse conditions impact transit time, delivery reliability, and efficiency and increase the prices of transported food. All modes of the U.S. transportation systems will be impacted, leading to economic and personal losses.<sup>cix</sup> Higher temperatures can cause



roads to buckle, while extreme weather events such as hurricanes will “inundate and damage transportation infrastructure, resulting in delayed delivery of goods and services.”<sup>cx</sup> Hurricanes on the Atlantic coast are projected to increase in frequency and intensity, as well as to further encroach inland where infrastructure is not designed to cope, where “the resulting flooding, wind damage, and bridge destruction disrupts virtually all transportation systems in the affected area.”<sup>cxii</sup> Wildfires can also impair visibility, leading to grounded planes and disruptions in air traffic. Beyond transport, extreme weather events can also damage food storehouses and distribution centers.<sup>cx</sup>

The connections between climate change and vulnerabilities in food processing are less clear. A report by the *New York Times*<sup>cxiii</sup> examined how U.S. meat processing takes place in a small number of facilities, which affected the supply of beef during the COVID-19 pandemic. For beef alone, around 98% of processing happens in a little over 50 plants, creating a “bottleneck” in the supply chain<sup>cxiii</sup> and leaves these facilities vulnerable in the case of extreme weather that might cause machine failures, power outages, or worker illnesses that can shutdown facilities. The resulting meat shortage and/or price increase can affect restaurants. Higher temperatures, increased humidity, and rising sea levels are likely to additionally stress on production infrastructure, such as machinery, transportation electricity networks, and telecommunications.”<sup>cxiv</sup>

## Summary of Main Points

**Threat to Production—Floods:** In Kerala, India, heavy flooding due to climate change was attributed to the decrease in production of key spices, including black pepper, cardamom, nutmeg, clove, ginger, and turmeric totaling 25,000 metric tons. Spices are especially sensitive to climate-related weather events. Projected trends indicate an increase in demand for the Indian spice market; however, the Indian spice market may not be able to meet demand due to worsening climatic conditions.

**Threat to Production – High Price Inputs:** Farmers must purchase a sufficient number of inputs needed to produce the desired number of crops. The cost

of inputs such as fertilizers, seeds, and farming equipment, have soared because of supply chain production and distribution issues. Due to the price constraint, which shows no indication of returning to normal, manufacturers are prevented from reaching their typical outputs. These cost increases can be seen throughout the whole supply chain, from production to final delivery.

**Threat to Distribution and Processing—Extreme Weather Events:** The processing and distribution infrastructure does not have the capacity to cope with extreme weather events which result in blocked transportation. For example, the ongoing drought in Panama in the summer of 2023 caused low water levels in the canal, which prevented the flow of traffic. Wait times at the canal increased to several weeks, raising concerns about spoilage, which could negatively impact the health of consumers.

## Conclusion

- **Extreme Weather Impacts Transit:** Extreme weather events cause increases in transit time, and difficulties with distribution reliability and efficiency. Navigating a backed-up transportation system increases the prices of all commodities transported, including food.
- **Issues with Transit Impact Restaurants:** When transit issues disrupt the supply chain, restaurants can face significant challenges, impacting their operations and customer satisfaction.

# Conclusion: Finding the Sweet Spot

Through extreme weather events and warming temperatures, climate change is impacting food production globally.

Production is the most vulnerable area in food supply chains.<sup>lxxxvii, cxiv</sup> Climate-related production issues affect every part of the food supply chain. Climate change is “likely to affect global, regional, and local food security by disrupting food availability, decreasing access to food, and making food utilization more difficult.”<sup>cxiv</sup> Farmers are directly impacted, as their crop yield could be reduced, and these crop reductions have a trickledown effect to suppliers and restaurants. Reduced crop yield may cause supply chain disruptions, which can impact independent restaurants through increased prices, delayed deliveries, and potentially the inability to obtain certain products.

Low agricultural yields and current inflation are increasing the price of foods. At 8%, 2021 to 2022 saw the largest increase in restaurant food pricing in the past 40 years.<sup>cxv</sup> Furthermore, the USDA reports that all foods are expected to increase by 5.8% in 2023 alone.<sup>cxvi</sup> When asked about current issues restaurants are facing, the owner of an independent restaurant in

New York, stated that their “biggest challenge [...] is the drastic increase in food cost, specifically within the world of poultry, meat, and fish.”<sup>cxvii</sup>

Climate change is not impacting everyone equally;<sup>lxxxiii</sup> restaurants in some locations may be affected more than others. Many “farm to table” restaurants rely on local producers for their food supplies. If the farm and restaurant are located in relatively climate resilient areas, the impact of climate change may be small. However, many restaurants and farms are in areas that are vulnerable to disruptions. Some prime examples of variable disruptions due to climate change are droughts in Texas, hurricanes in Florida, wildfires in California, and temperature changes affecting seafood catch. These three states are extremely important to the industry considering over 30% of the independent restaurants in the U.S. are located in these states, have nearly 1 million employees, paying out \$20 billion in wages, and generating almost \$65 billion in revenue.<sup>i</sup>

## Texas

Texas' drought of 2011 resulted in 100% of the state being categorized in severe to exceptional drought which led to close to \$8 billion dollars in crop loss claims.<sup>cxix</sup> This pattern continued into 2012 with the following years seeing some relief. But in the past two years, Texas has experienced record-breaking temperatures, with 2023 being the hottest summer on record. These record temperatures led to severe droughts, although oddly they were still orders of magnitude less severe than 2011–12 drought. Unfortunately, these conditions will still lead to greater agricultural damage and claims will be far more substantial because consistent severe temperatures adversely affect growth rates and water availability. In 2022, crop loss claims rose to almost \$20 billion with less area affected than in 2011/2012 statewide drought. This is having a dramatic impact on specialty crops like pecans, peanuts, and peaches. One farmer lost 10% of his pecan orchard, which is also the state tree.<sup>cxix</sup> Peanut farmers had an expected yield reduction of at least 30%.<sup>cxix</sup> Peach orchards saw low yield and smaller fruit due to lack of rainfall and low water availability due to the drought.<sup>cxix</sup> Additionally, many livestock farmers are losing their feed crops to drought damage forcing them to purchase hay or choose to cull their herd to cut their losses.<sup>cxix</sup> Lastly, of the 29.5 million Texans, 21 million or 71% of the population have been affected by the recent droughts.<sup>cxix</sup>

## Florida

Florida, which is the largest producer of citrus fruit in the country, has been struggling with the effects of more intense and frequent hurricanes. Hurricane Ian hit Florida in late September 2022, resulting in \$400 million in loss of citrus crops and at least \$150 million in vegetable and other fruit loss along with an overall agriculture and aquaculture loss of \$800 million.<sup>cxixii</sup> This exemplifies the importance of specialty crops especially citrus in Florida agriculture which produces close to 60% of all citrus consumed by Americans.<sup>cxixii</sup> In a preliminary report, the University of Florida predicts that Hurricane Idalia which came ashore in late August 2023 affected 3.3 million acres of food producing land, including citrus, other fruit producing

orchards, livestock, row crops, and vegetables and melons. The wind damage only is estimated \$4 billion.<sup>cxixiii</sup>

These instances must be considered in context of the crop. Fruit and nut orchards are in high producing and climate-impacted states such as Florida, Texas, and California. But there is also consideration that needs to be heeded for lesser-known orchards such as apple producers in Washington, New York and Michigan, peach producers in South Carolina and Georgia, and pear producers in Oregon and Washington.<sup>cxixiv</sup> All of these orchards face a larger challenge than other specialty crops. Trees don't move and they don't grow back and produce fruit in a year. Such orchards are traditionally family owned for generations because trees can live for generations to support the continuation of the farming legacy. Therefore, these large-scale climate-related disruptions are not a one-time disruption. They can destroy a farm's entire livelihood in one season. This is clearly important for smaller family-owned farms.

## California

California has experienced many international news-worthy wildfires such as the Camp and Valley Fires in the past few decades. Of the top 20 largest California wildfires recorded since 1932, 18 out of the 20 have occurred in the past 20 years with 9 of those occurring the past 3 years.<sup>cxixv</sup> In 2023, year-to-date there have been over 300,000 acres affected by more than 7,400 wildfires.<sup>cxixvi</sup> Most astonishingly, in 2020 over 4 million acres were affected.<sup>cxixvii</sup>

As noted by the California State Assembly, most of this didn't affect agricultural production except for vineyards and grazing lands. In the same assembly meeting, Jamie Johansson, President of the California Farm Bureau Federation, made note of how wildfires have been impacting agriculture in various ways from increased claims and damage, power outages preventing farmers from irrigating to save their crops, increases in insurance premiums, to lack of masks for workers.<sup>cxixvii</sup> Vineyards are especially vulnerable to wildfire destruction, not just the threat of crop loss but also due to smoke taint. Smoke taint is when smoke

exposure causes the crop to taste differently than intended. On top of having to choose to create a smoke tainted wine or send a tainted grape to the grocery store, grape producers don't have any right to insurance claim under the current definition of crop loss.<sup>cxviii</sup>

For winemakers, this will be a continuing concern for operation under climate change. Most vineyards affected didn't produce a 2020 vintage, but some had no choice but to produce wine because of budget challenges. It is a gamble because although 20% of people can't taste smoke-taint, the winemaker risks their reputation with the other 80% who can taste it. This clearly extends to the independent restaurant industry and their relationship with their customers. If a restaurant is serving a tainted wine, do they have to explain the reason for the smokiness, the flavor, and the smell that has changed since the last vintage? These questions illustrate how the restaurant is then putting their own reputation at risk. These downstream effects of climate change complicate a restaurant's ability to source and source well quality product for their customers. But there is a choice for both the restaurant and the winemaker, to choose the practices that support climate readiness and resilience. There are many ecological strategies that can both make the land more fire resistant as many farmers have found with small fire management strategies and through prophylactic treatment of grapes to prevent wine taint.<sup>cxix</sup> In the end, there is no magic bullet to prevent climate-related damage but thoughtful and collaborative interventions that help to nourish the land for future growth.

## Seafood

Seafood consumption increased in the U.S. by 75% between 1968 and 2020, from 11 pounds per year to 19 pounds per year per capita. As consumption increased, so did the diversity of options in domestic seafood production in both wild-caught and farm-raised species. American domestic seafood production increased 120% over those 50 years, with 5.3 metric tons of domestic seafood occurring in 2019.<sup>cxx</sup>

This rise in consumption has made the impact of climate change on fisheries increasingly evident, with



**JJ Johnson**

**FIELDTRIP  
New York, NY**

"For me, it's salmon. I buy salmon because people love it. But I haven't bought salmon in springtime, prime-time salmon in a long time, because there's not enough product anymore. And most of the salmon we get is farmed and if it is wild, it's not the best salmon in the world. But I get it. And I try to find the best, based off the price range we have, because I know people love it."

notable consequences for both marine ecosystems and consumer choices.<sup>lxxvii, cxxx-cxxxiii</sup> American fisheries are crucial, harvesting approximately 5 million metric tons of fish and shellfish annually.<sup>lxxvii</sup> However, they face mounting challenges due to climate change, which is compounding stressors such as overfishing and water pollution.<sup>lxxvii, cxxx-cxxxiii</sup>

The shifting distribution of marine species is one notable effect of climate change, as many species migrate northward in response to rising temperatures.<sup>lxxvii, cxxxii</sup> Black sea bass, American lobster, and red hake have each migrated an average of 119 miles northward.<sup>lxxvii</sup> Migration introduces species into new territories, where they compete for limited resources and disrupt local ecosystems. Higher water temperatures, ocean salinity, and acidification also bring parasites and disease, as seen in Arctic salmon in the Bering Sea and oyster parasites that have spread across the northern Atlantic coast.<sup>lxxvii, cxxxii</sup>

Climate change also influences seafood availability and consumption patterns in the United States.<sup>cxx</sup>

<sup>cxix</sup> U.S. per capita consumption has significantly increased over the years, with consumers shifting towards farm-raised and sustainably certified fish. Changing marine environments are affecting the composition of seafood catches, particularly in locations where local fisheries significantly contribute to domestic seafood supply.<sup>cxix</sup> As marine species shift their distribution in response to rising temperatures, there is an increase in the dominance of warm water species.<sup>cxix-cxxi</sup> This shift has economic implications, affecting seafood prices, supply chains, and consumer preferences.<sup>cxix, cxxiv</sup> Restaurant menus, which often highlight locally sourced seafood, are becoming an indicator of these changes, reflecting shifts in the availability of different fish species.<sup>cxix-cxxi</sup> As climate change continues to accelerate, so do the significant threats to “blue food.” Blue food consists of thousands of fish, shellfish, plants, and algae that sustain 3.2 billion people worldwide. The United States is currently facing a substantial threat to its marine food supplies,<sup>cxixiii</sup> which will only flow down the seafood chain to fisheries, seafood retailers, and eventually restaurants.<sup>cxixiv</sup>

## Conclusion

In an industry which has extremely tight profit margins, 4.2%, and purchases accounting for over 40% of their cost, the supply chain remains a heavy burden for independent restaurants.<sup>i</sup> As climate change progresses, more areas of our country will be affected. How a restaurant is affected by climate change often depends on the type of food they serve. Reductions in cornerstone crops, such as oats, wheat, and rice are already affected by climate change. Reduced crop yields increase the price of foods and reduce food security, forcing independent restaurants to increase the amount of money they must spend on their materials. For many of these crops, there is no easy alternative foods if costs are too high. Restaurants will be unable to source their needed product and make them more vulnerable to closure.

Climate change is an urgent threat that significantly affects our food supply chain, and this impact ripples through communities, economies, farmers, the fishing industry, and restaurant owners alike. As climate

change disrupts traditional weather patterns, alters growing seasons, intensifies extreme weather events, and leads to biodiversity loss, agricultural productivity and stability are jeopardized. Farmers, the foundation of the food supply chain, face unpredictable yields and increased vulnerability to pests and diseases. This uncertainty affects the consistent and reliable sourcing of ingredients for restaurants.

By adopting sustainable food policies and practices, the agricultural community and restaurant industry can mitigate these challenges. Sustainable farming practices, such as crop diversification, regenerative farming, efficient water, and energy use, and reduced chemical usage can enhance resilience to climate change and ensure a stable supply of quality produce. For restaurant owners, sourcing from local, sustainable farms not only supports farmers but also guarantees fresher, more nutritious, and higher-quality ingredients. Moreover, sustainable policies promote



### John Palladino

**Restaurant Manager  
Great American  
Restaurant Group  
Maryland and Virginia**

“Supply chain issues are almost a daily basis and there have been more disruptions in the past three years than ever before. Fishermen don’t go out during a hurricane, so it prevents you from sourcing a specific type of fish. The same is true for droughts in certain regions will devastate a particular crop and you’re left trying to find it from another area.”



ethical sourcing, reduce waste, minimize carbon footprints, and align with consumer preferences for environmentally conscious dining experiences.

Collaboratively, the adoption of sustainable food policies creates a win-win situation. Farmers benefit from stable markets and improved resilience, the environment benefits from reduced strain, and the restaurant industry benefits from a reliable, high-quality supply chain. Ultimately, by prioritizing sustainability, we build a more resilient and ethical food system that is better equipped to withstand the challenges of climate change while supporting communities, economies, and the planet.



**James Beard Award Winner**

**Mary Sue Milliken**

**Julia Child Award Recipient,  
Cookbook Author,  
Media Personality, and  
Food System Activist**

**Border Grill, Socalo,  
BBQ Mexicana, and Alice B.**

**Los Angeles and  
Palm Springs, CA; and  
Las Vegas, NV**

“A challenge that happens a lot is we will be prepared for a big weekend, because we project sales based on the rhythms of the businesses’ sales, and then there will be a wildfire and the concentration of smoke will be so severe, people will opt not to leave their homes. We get stuck with food, beverage, and labor bills but no sales to offset them.”



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