Journal of Food Law & Policy

Volume 19 | Number 1 Article 7

2023

Climate Change, Food Security, and the Myth of Unlimited Abundance

Susan A. Schneider
University of Arkansas School of Law

Climate Change, Food Security, and the Myth of Unlimited Abundance

Susan A. Schneider*

The Biden-Harris White House can be commended for convening the historic White House Conference on Hunger, Nutrition, and Health highlighting the critical connections between access to healthy food and sustaining a healthy population.[1] Similarly, this administration can be praised for its separate recognition of climate change as an existential threat and its efforts to reduce greenhouse gases.[2] However, the White House Conference failed to consider the impact that climate change will have on the issues of hunger, nutrition, and health. This article explores this impact and seeks to fill a critical gap in the national discussion. It argues that dramatic changes are needed in the way we think about domestic food security and that meaningful change will be required to assure an adequate supply of healthy food, as envisioned by the White House Conference.

Much of the focus of current climate change policy is on ways to reduce our impact. Public-private partnerships, incentives, regulations, and other policy tools are critical to our efforts to reduce greenhouse gases and mitigate the harm caused to our ecosystem. This article supports these vital initiatives but does not address them. Rather, it explores the impact of the changes to the climate that are already in motion and argues that there is an immediate need to prepare for the impact, even as we attempt to reduce further harm.

Climate change will likely prove to be the most devastating disruption to food security that the modern world has ever seen. It has already begun to impact food production, and it is a threat global

* Professor Susan Schneider is the William H. Enfield Professor of Law and serves as Director of the LL.M. Program in Agricultural & Food Law at the University of Arkansas School of Law.

[1] *White House Conference on Hunger, Nutrition, and Health, Washington, D.C.* (September 28, 2022), https://health.gov/our-work/nutrition-physical-activity/white-house-conference-hunger-nutrition-and-health.

[2] *See, e.g.,* Exec. Order No. 14008 (Jan. 27, 2021), *reprinted as* 86 Fed. Reg. 7619 (Feb. 1, 2021) (acknowledging the "profound climate crisis" and stating that "we have a narrow moment to pursue action").

food security. This is not just a problem for developing countries; it is a looming threat to agricultural food crops in the U.S., risking our supply of healthy foods and raising food prices far above current levels.

This article outlines the direct impact of climate change on food production. Accentuating the danger of this impact, it explores the U.S. dependency on concentrated production areas that are particularly vulnerable to climate change. It then reveals the lack of coordinated federal policies to protect our food system, calling into question the American myth of unlimited agricultural abundance that underlies agricultural policy. The article concludes with a call for a radical realignment of our attitude and policies regarding food.

I. The Direct Impact of Climate Change

In 2018, the United States Department of Agriculture (USDA) National Climate Assessment concluded:

> Rising temperatures, extreme heat, drought, wildfire on rangelands, and heavy downpours are expected to increasingly disrupt agricultural productivity in the United States. Expected increases in challenges to livestock health, declines in crop yields and quality, and changes in extreme events in the United States and abroad threaten rural livelihoods, sustainable food security, and price stability.[3]

Climate change impacts have only increased since this assessment.[4]

---

[3] U.S. GLOB. CHANGE RSCH. PROGRAM, *Climate Change, Global Food Security, and the U.S. Food System*, U.S. DEP'T OF AGRIC., UNIV. CORP. FOR ATMOSPHERIC RSCH., NAT'L CTR FOR ATMOSPHERIC RSCH. (Dec. 2015), https://www.usda.gov/sites/default/files/documents/FullAssessment.pdf.

[4] Jeff Tollefson, *Climate Change Is Hitting The Planet Faster Than Scientists Originally Thought,* NATURE (Feb. 28, 2022), https://www.nature.com/articles/d41586-022-00585-7 (reporting on an IPCC climate report that warns that "rising greenhouse-gas emissions could soon outstrip the ability of many communities to adapt").

Climate change has already had a devastating impact on food production worldwide.[5] While mid- and low latitude regions have experienced the most negative impact to date, as the planet continues to warm, there is a looming threat to global food production, including U.S. food production. This puts our domestic food security at risk.[6] This initial section of the article introduces the six ways in which climate change directly hampers food production. Each is anticipated to increase in its negative impact as climate change becomes more pronounced. These six direct negative impacts are: 1) elevated temperatures impairing crop and livestock production; 2) the increased incidence of extreme weather causing increased damage to crops and livestock; 3) climate change-influenced conditions reducing the nutritive value of crops produced; 4) an increase in the range and damage associated with agricultural insect pests and diseases; 5) warmer temperatures and erratic weather events increasing the vulnerability of vital pollinators; and 6) sea level rise and the salinization of coastal soils reducing coastal agricultural acreage and productivity.

A. Elevated temperatures impair crop and livestock production.

The Climate Change Indicators posted by the Environmental Protection Agency (EPA) reveal that since the 1979, average temperatures in the contiguous forty-eight states of the U.S. have risen 0.32 to 0.55°F per decade.[7]

> Since 1896, average winter temperatures across the contiguous 48 states have increased by nearly 3°F. Spring temperatures have increased by about 2°F,

[5] Ariel Ortiz-Bobea et al., *Anthropogenic Climate Change Has Slowed Global Agricultural Productivity Growth*, 11 NATURE CLIMATE CHANGE 306 (2021) (finding that anthropogenic climate change has reduced global agricultural productivity growth by 21% since 1961).

[6] U.S. GLOB. CHANGE RSCH. PROGRAM, *supra* note 3.

[7] *Climate Change Indicators: U.S. and Global Temperature*, ENV'T. PROT. AGENCY, https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-temperature (last visited Mar. 30, 2023).

> while summer and fall temperatures have increased by about 1.5°F.[8]

This is consistent with the increase in temperatures documented globally. The National Oceanic and Atmospheric Administration's (NOAA), survey of "Climate by the Numbers" provides:

> Earth's average land and ocean surface temperature in 2022 was 1.55 degrees F (0.86 of a degree C) above the 20th-century average of 57.0 degrees F (13.9 degrees C) — the sixth highest among all years in the 1880-2022 record.
>
> It also marked the 46th-consecutive year (since 1977) with global temperatures rising above the 20th-century average. The 10-warmest years on record have all occurred since 2010, with the last nine years (2014-2022) among the 10-warmest years.[9]

In our Northern Hemisphere, "surface temperature was also the sixth highest in the 143-year record at 1.98 degrees F (1.10 degrees C) above average."[10]

This increase in temperature has extended the average length of the growing season in all but two states within the contiguous United States.[11] The growing season has increased more than two weeks since 1901 with a "particularly large and steady increase" over the last 30 years."[12]

Some northern regions welcome the longer growing season. However, it comes with countervailing costs. Rising temperatures increase the volatility of weather patterns, making weather prediction increasingly difficult.[13] Pests, pathogens, and invasive species increase because the longer growing season allows for additional

---

[8] *Id.*
[9] *2022 Was the World's 6th-Warmest Year on Record*, DEP'T OF COM., NAT. OCEANIC & ATMOSPHERIC ADMIN. (Jan. 12, 2023), https://www.noaa.gov/news/2022-was-worlds-6th-warmest-year-on-record.
[10] *Id.*
[11] *Climate Change Indicators: U.S. and Global Temperature*, *supra* note 7, (last visited Mar. 30, 2023) (referencing exceptions for Alabama and Georgia).
[12] *Id.*
[13] Josie Garthwaite, *Climate of Chaos: Stanford Researchers Show Why Heat May Make Weather Less Predictable*, STANFORD NEWS (Dec. 14, 2021), https://news.stanford.edu/2021/12/14/warming-makes-weather-less-predictable/.

generations, often without winter die-off.[14] And the hotter temperatures during the extended season are problematic, even in the north.[15] Elevated temperatures have been shown to reduce global crop yields for major row crops.[16] Warmer temperatures increase evaporation, drying out soil and vegetation, increasing the need for rainfall or irrigation and increasing the risk and severity of drought.[17] Increased heat and drought risk is predicted to impact cropping patterns, "displacing existing growers and affecting farming communities."[18]

Consider the following specific crop concerns associated with the increasing temperatures during the growing season:

- Heat stress during pollination can negatively impact fertilization and reduce production. For example, heat stress during pollination can impact fertilization and cause "kernel abortion," reducing the number of seeds that develop on the plant; temperatures above 93 degrees F. have "severe impacts on pollen viability" of small grains.[19] Similarly, corn pollen is "no longer viable once temperatures reach the mid 90's or

[14] Renee Cho, *How Climate Change Will Affect Plants*, STATE OF THE PLANET, COLUMBIA CLIMATE SCH. (Jan. 27, 2022), https://news.climate.columbia.edu/2022/01/27/how-climate-change-will-affect-plants/.

[15] For example, a 2020 Minnesota Extension Service blog discussed the problems that heat stress causes in small grain pollination. *See* Jared Goplen & Jochum Wiersma *Heat Stress on Small Grains*, MINN. CROP NEWS, UNIV. OF MINN. EXTENSION SERV. (June 24, 2020), https://blog-crop-news.extension.umn.edu/2020/06/heat-stress-on-small-grains.html.

[16] *See* Chuang Zhao et al., *Temperature Increase Reduces Global Yields of Major Crops in Four Independent Estimates*, 114 PNAS No. 35 (Aug. 15, 2017), https://www.pnas.org/doi/full/10.1073/pnas.1701762114, (finding a reduction in wheat, rice, maize, and soybean crops).

[17] *See Megadrought in Southwest is Now the Worst in 1200 Years*, COLUMBIA CLIMATE SCH. (Feb. 14, 2022), https://news.climate.columbia.edu/2022/02/14/megadrought-in-southwest-is-now-the-worst-in-at-least-1200-years-study-confirms/ (last visited Apr. 3, 2023).

[18] *See* Emile Elias et al., *Southwest Regional Climate Hub and California Subsidiary Hub Assessment of Climate Change Vulnerability and Adaptation and Mitigation Strategies*, 14, U.S. DEP'T OF AGRIC. (Aug. 2015), https://www.fs.usda.gov/research/treesearch/49341 (hereinafter, *2015 Southwest Regional Assessment*).

[19] Goplen & Wiersma, *supra* note 15.

> greater, especially with low relative humidity."[20]
>
> - Many crops depend on nighttime cooling periods that will not be met as temperatures rise. For example, high nighttime temperatures lower corn yield, reducing the kernel numbers produced and the weight of the kernels.[21]
>
> - Many perennial crops depend on "winter chilling" periods that are predicted to decrease below that necessary for production. For example, the winter chill periods for many California fruit and nut trees are projected to fall below that which is needed, resulting in lower yields and making some crops unviable.[22]

Elevated temperatures increase evaporation rates, exacerbating drought conditions. This was exemplified by conditions in the summer of 2022 when drought and elevated temperatures impacted large areas of the U.S. In September 2022, the Washington Post reported on the "hefty toll" that heat and drought had taken on U.S. agricultural crops, leading with the statement that 2022 "was a bad year for corn. And for tomatoes. And for many other crops."[23]

Similar problems are experienced in livestock production, with increasing production concerns apparent. Livestock productivity and health declines as heat stress disrupts animals' metabolisms.

> At higher temperatures, [cattle] reduce their feed intake by 3–5% per additional degree of temperature, reducing productivity. Heat stress

---

[20] *See, e.g.*, *Corn Pollination: Effect of High Temperature and Stress,* IOWA STATE UNIV. EXTENSION & OUTREACH, https://crops.extension.iastate.edu/encyclopedia/corn-pollination-affect-high-temperature-and-stress (last visited Apr. 16, 2023) (discussing drought and heat stress in corn).

[21] *See, e.g.*, *Nighttime Temperatures Impact Corn Yield*, C.O.R.N. NEWSL., AGRONOMIC CROPS NETWORK, OHIO STATE UNIV., https://agcrops.osu.edu/newsletter/corn-newsletter/2018-24/night-temperatures-impact-corn-yield (last viewed Apr. 2, 2023) (discussing the importance of nighttime temperature ranges to corn production).

[22] *2015 Southwest Regional Assessment*, *supra* note 18 at 14.

[23] Laura Riley, *The Summer Drought's Hefty Toll on American Crops,* WASH. POST (Sept. 5, 2022), https://www.washingtonpost.com/business/2022/09/05/crops-climate-drought-food/ (addressing heat and drought conditions).

> increases respiration and mortality, reduces fertility, modifies animal behaviour, and suppresses the immune and endocrine system, thereby increasing animal susceptibility to some diseases. These changes can affect the economic performance of dairy and beef production systems.[24]

As a tragic example, in the summer of 2022, in Kansas, "thousands of cattle in feedlots in southwestern Kansas [] died of heat stress due to soaring temperatures, high humidity and little wind."[25]

Poultry are particularly vulnerable to heat stress, with severe implications for both egg and meat production. High temperatures have been found to cause a "decrease in growth rate, body weight, egg production, egg weight, egg quality, meat quality, semen quality, fertility and hatchability. . . Additionally, heat burden during transportation of birds from one place to another leads to reduced meat quality, increased mortality and welfare issues."[26] Recent commercial genetic selection strategies focused maximum production and feed efficiency have actually made poultry flocks more susceptible to heat stress.[27]

Pigs are also extremely sensitive to heat stress, with impacts that include reduced feed intake and growth, infertility, health problems for sows during pregnancy, reduced litters, reduced piglets surviving, decreased milk production in lactating sows (reducing piglet health and growth), and increased mortality.[28]

---

[24] Phillip Thornton et al., *Impacts of Heat Stress on Global Cattle Production During The 21st Century: A Modelling Study*, 6 THE LANCET 192 (Mar. 2022).
[25] Roxana Hegeman, *Heat Stress Blamed for Thousands of Cattle Deaths in Kansas*, U.S. NEWS & WORLD REP. (June 16, 2022), https://www.usnews.com/news/us/articles/2022-06-16/heat-stress-blamed-for-thousands-of-cattle-deaths-in-kansas.
[26] Manoj Kumar et al., *Climate Change and Heat Stress: Impact On Production, Reproduction And Growth Performance Of Poultry and Its Mitigation Using Genetic Strategies,* 97 J. THERMAL BIOLOGY 102,867, 1 (2021).
[27] *Id*., at 5.
[28] *Heat Stress in Swine Affects Production*, UNIV. OF MINN. EXTENSION SERV. (2019), https://extension.umn.edu/swine-production-management/heat-stress-swine-affects-production#effects-on-the-breeding-herd-255311. *See also*, Ann Hess, *Improving Heat Stress Resilience Should Be Priority For Swine Industry,* NAT'L HOG FARMER (July 18, 2022), https://www.nationalhogfarmer.com/animal-health/improving-heat-stress-resilience-should-be-priority-swine-industry (discussing research on financial losses associated with heat stress in hog populations).

B. Extreme weather events have increased because of climate change.

"Extreme weather events" which include extreme heat, severe drought, heavy precipitation, flooding, and high winds have increased dramatically due to climate change. They "have more than doubled in frequency over the last 25 years."[29] The National Oceanic and Atmospheric Administration's monitoring of "Billion Dollar Weather and Climate Disasters" documents this increase.

> In 2021, there were twenty weather/climate disaster events with losses exceeding $1 billion each to affect the United States. These events included one drought event, two flooding events, eleven severe storm events, four tropical cyclone events, one wildfire event, and one winter storm event. Overall, these events resulted in the deaths of 724 people and had significant economic effects on the areas impacted. The 1980–2021 annual average is 7.7 events (CPI-adjusted); the annual average for the most recent five years (2017–2021) is 17.8 events (CPI-adjusted).[30]

In 2022, there were eighteen "billon dollar" disasters, including the record drought that impacted many areas of prime agricultural production.

> Drought coverage across the contiguous U.S. remained significant for the second year in a row, with a minimum extent of 44% occurring on September 6 and a maximum coverage of 63% on October 25 — the largest contiguous U.S. footprint since the drought of 2012.

---

[29] Chase Sova et al., *Climate Change and Food Security: A Test of World Leadership in a Fragile World*, CTR FOR STRATEGIC & INT'L STUD. (October 15, 2019), https://www.csis.org/analysis/climate-change-and-food-security-test-us-leadership-fragile-world.

[30] *Billion-Dollar Weather and Climate Disasters*, NAT'L CTRS FOR ENV'T. INFO., DEP'T OF COM., NAT'L OCEANIC ATMOSPHERIC ADMIN., https://www.ncei.noaa.gov/access/billions/ (last viewed Apr. 2, 2023).

> In the western U.S., drought conditions reached a peak coverage of 91.3% of the region on May 3. Drought coverage across the West shrank as the summer monsoon reduced some of the coverage in the Southwest. The multi-year western U.S. drought resulted in water stress/shortages across many locations in 2022 as some major reservoirs dropped to their lowest levels on record.[31]

In addition to drought, in 2022, the U.S. had billion-dollar wildfires, flooding, tornadoes, tropical cyclones, winter storms, and severe wind/hail, including a derecho event in the central U.S for a total estimated damage cost of $165 billion.[32]

As climate change increases, these extreme events are predicted to continue to become more frequent.

> With increasing global surface temperatures, the possibility of more droughts and increased intensity of storms will likely occur. As more water vapor is evaporated into the atmosphere it becomes fuel for more powerful storms to develop. More heat in the atmosphere and warmer ocean surface temperatures can lead to increased wind speeds in tropical storms. Rising sea levels expose higher locations not usually subjected to the power of the sea and to the erosive forces of waves and currents.[33]

C. Food crops grown in climate change-influenced conditions have less nutritive value.

An increased level of carbon dioxide in the atmosphere, as is associated with climate change, can increase the growth rate of

---

[31] *Record Drought Gripped Much of the U.S. in 2022*, NAT'L OCEANIC ATMOSPHERIC ADMIN. (Jan. 10, 2023), https://www.noaa.gov/news/record-drought-gripped-much-of-us-in-2022.
[32] *Id*.
[33] *How Can Climate Change Affect Natural Disasters*, U.S. GEOLOGICAL SOC'Y, https://www.usgs.gov/faqs/how-can-climate-change-affect-natural-disasters (last viewed Apr. 3, 2023); *see also, Extreme Weather and Climate Change*, CTR FOR CLIMATE & ENERGY SOL., https://www.c2es.org/content/extreme-weather-and-climate-change/ (last viewed Apr. 3, 2023).

some plants.[34] However, studies have also shown that increased levels of ozone and carbon dioxide, combined with increases in temperature, cause a marked decrease in the food quality and the nutritive values of crops produced.[35] Crops grown under elevated atmospheric CO2 concentrations are found to contain less protein; crops particularly affected include rice and wheat, important sources of dietary protein.[36]

> With elevated CO2, protein concentrations in grains of wheat, rice and barley, and in potato tubers decreased by 10 to 15 percent in one study. Crops also lose important minerals including calcium, magnesium, phosphorus, iron, and zinc. A 2018 study of rice varieties found that while elevated CO2 concentrations increased vitamin E, they resulted in decreases in vitamins B1, B2, B5 and B9.[37]

Additional studies have confirmed the loss of protein and found diminishing levels of zinc and iron in food crops raised at higher CO2 levels.[38] "[R]ecent research has shown that with highly elevated concentrations of atmospheric carbon dioxide (CO2), iron and zinc content in plants could fall by as much as 17 percent, accompanied by an increase in starches and sugar production in plants."[39]

> Livestock feed is also impacted. As the EPA notes:
>
> Elevated CO2 has also been associated with reduced protein and nitrogen content in alfalfa and soybean

---

[34] Cho, *supra* note 14.

[35] Helena B. Evich, *The Great Nutrient Collapse*, POLITICO (Sept. 13, 2017), https://www.politico.com/agenda/story/2017/09/13/food-nutrients-carbon-dioxide-000511/. *See also*, 2018 NATIONAL CLIMATE ASSESSMENT, *Ch. 25 Southwest*, at 1127 (associating elevated temperatures with crop failures, reduced yields, and reduced quality).

[36] Danielle E. Medek et al., *Estimated Effects of Future Atmospheric CO2 Concentrations on Protein Intake and the Risk of Protein Deficiency by Country and Region,* 125 ENV'T HEALTH PERSP. (Aug. 2, 2017).

[37] Cho, *supra* note 14.

[38] *Climate Change and Nutrition*, HARVARD T.H. CHAN SCH. OF PUB. HEALTH https://www.hsph.harvard.edu/c-change/subtopics/climate-change-nutrition/ (citing "Research led by Sam Myers, Director of the Planetary Health Alliance at the Harvard Chan School, [that] found that when food crops like wheat, corn, rice and soy are exposed to CO2 at levels predicted for 2050, the plants lose as much as 10% of their zinc, 5% of their iron, and 8% of their protein content.").

[39] Sova *supra* note 29 (citing Matthew Smith & Samuel Myers, *Impact of Anthropogenic CO2 Emissions on Global Human Nutrition*, 8 NATURE CLIMATE CHANGE 834-39 (2018)).

> plants, resulting in a loss of quality. Reduced grain and forage quality can reduce the ability of pasture and rangeland to support grazing livestock.[40]

Elevated CO2 levels are similarly linked to a decline in protein concentration in goldenrod, a very important source of food for bees.[41]

D. Damage from agricultural insect pests is increasing because of climate change.

Increased pest damage is another consequence of climate change that impacts food production. Warmer temperatures, particularly in the winter, allow agricultural pests to thrive, with some pests surviving year-round and new pests and diseases emerging.

> Changes in climate can affect insect pests in several ways. They can result in an expansion of their geographic distribution, increased survival during overwintering, increased number of generations, altered synchrony between plants and pests, altered interspecific interaction, increased risk of invasion by migratory pests, increased incidence of insect-transmitted plant diseases, and reduced effectiveness of biological control, especially natural enemies. As a result, there is a serious risk of crop economic losses, as well as a challenge to human food security.[42]

---

[40] *Climate Impacts on Agriculture and Food Supply*, CITY OF CHICAGO, ENV'T. PROT. AGENCY (citing Jerry Hatfield et. al., THIRD NATIONAL CLIMATE ASSESSMENT, 2014), https://climatechange.chicago.gov/climate-impacts/climate-impacts-agriculture-and-food-supply.

[41] Holly Holt, *Global Warming*, DEP'T OF ENTOMOLOGY, PENN STATE COLL. OF AGRIC. SCI., https://ento.psu.edu/research/centers/pollinators/resources-and-outreach/disappearing-pollinators/global-warming, (citing L.H. Liska, et al, *Rising Atmospheric CO2 Is Reducing the Protein Concentration of a Floral Pollen Source Essential For North American Bees,* PROC. R. SOC. B BIOL. SCI. 283, 20160414 (2016)).

[42] Sandra Skendžić et al., *The Impact of Climate Change of Agricultural Insect Pests*, INSECTS (May 2021), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8150874/.

As one concrete example, researchers at the University of California Davis found that the codling moth, a common agricultural pest of fruit and nut orchards may increase its lifespan from two to three or even four generations per year because of the long, warm summers and late, mild winters associated with climate change.[43]

E. The vulnerability of vital pollinators is exacerbated by climate change.

According to the USDA, "three-quarters of the world's flowering plants and about 35% of the world's food crops depend on animal pollinators to reproduce."[44] Over 100 U.S. crops, including some of our most healthy food crops, depend on pollinators.[45] "Pollination services from honeybees and other insects provide the backbone to ensuring our diets are diverse and plentiful with fruits, nuts, and vegetables."[46] The well-being of these insects is critical to "U.S. agriculture, food security, and the Nation's overall economy."[47] They "add tens of billions of dollars to the value of agricultural crops annually."[48] Many specialty crops including "almonds, cherries, and watermelons are completely dependent on insect pollination."[49]

Pollinator populations have declined drastically in recent years, due to a variety of physical stresses including pesticides, pathogens, and habitat loss.[50] Extreme weather and rising temperatures from climate change are now providing even further

---

[43] *See 2015 Southwest Regional Assessment*, *supra* note 18 at 14. *See also*, Cho, *supra* note 14.

[44] *The Importance of Pollinators*, U.S. DEP'T OF AGRIC., https://www.usda.gov/peoples-garden/pollinators (last visited Apr. 3, 2023).

[45] Casey C. Keel, *The Buzz about Pollinators*, U.S. DEP'T OF AGRIC. (June 22, 2022), https://www.usda.gov/media/blog/2022/06/22/buzz-about-pollinators.

[46] U. S. DEP'T OF AGRIC., POLLINATORS, https://www.usda.gov/pollinators (last visited Apr. 15, 2023).

[47] *USDA Annual Strategic Pollinator Priorities Report,* OFFICE OF THE CHIEF SCIENTIST, U.S. DEP'T OF AGRIC. (2022), https://www.usda.gov/sites/default/files/documents/annual-pollinator-report-2022.pdf.

[48] *Id*.

[49] *2015 Southwest Regional Assessment*, *supra* note 18 at 14.

[50] *Disappearing Pollinators,* DEP'T OF ENTOMOLOGY, PENN STATE COLL. OF AGRIC. SCI., https://ento.psu.edu/research/centers/pollinators/resources-and-outreach/disappearing-pollinators (last visited Apr. 3, 2023).

stress to these vulnerable populations. Warmer temperatures are shifting the growing and the blooming seasons for many of the plants that the pollinators depend on.[51] This disrupts the pollinator's life cycle and can result "in a mismatch in pollinator availability and crops to be pollinated.[52] Weather stresses also can negatively impact the "quantity and quality of nectar and pollen" produced by plants.[53] Pollinator health can also be directly impacted by changing environmental conditions.

> For example, warmer winters are linked to lower survival of bee species that overwinter as adults. Unseasonably warm winters raise bees' metabolisms. As a result, bees burn more calories and deplete their energy stores at a faster pace. Indeed, bees may emerge earlier in the spring with lower body weight. Altered weather may also signal bees to emerge from quiescent phases when important plant species are not in bloom.[54]

F. Coastal Land Loss

While each of the prior climate change impacts applies in varying degrees across the country, coastal areas are distinctly vulnerable to sea level rise (SLR), one of the most widely recognized effects of climate change. Coastal areas are impacted by the direct loss of land to rising sea levels and to damage to adjacent land due to salt-water intrusion and increased soil salinity.[55] The eastern and southeastern regions are particularly vulnerable.

Recent studies on the Mid-Atlantic region of Maryland and Virginia show that SLR is already making "chronic change to the

---

[51] *Pollinators and Climate Change*, NAT'L PARK SERV., https://www.nps.gov/articles/000/pollinators-climateimpact.htm (last visited Apr. 3, 2023).

[52] C.M Goode et al., *Impacts Of Climate Change On The Livestock Food Supply Chain; A Review Of The Evidence,* 28 GLOB. FOOD SEC. 100488, at § 2.114 (Mar. 2021).

[53] Holt *supra* note 41.

[54] *Id.*

[55] *See generally*, Sadat Mazhar et al., *Impacts of Salinization Caused by Sea Level Rise on The Biological Processes Of Coastal Soils - A Review,* 10 J. FRONTIERS IN ENVTL. SCI. (2022).

landscape."[56] The USDA Northeast Climate Hub reports that "[s]altwater flooding, due to sea level rise and more frequent and intense storm events, has become an increasing problem for farmers near coastal lands."[57]

The Southeast Climate Hub describes soil salinization in the region as "becoming more prevalent as storm surges increase in frequency and sea level rises."[58] Salinization "reduces the productivity of working lands and can prevent crops from growing."[59] The outlook for coastal farmland in the southeast is concerning.

> Salinization is expected to increase in vulnerable areas as sea levels continue to rise. Rising sea levels will inundate lands, increase tide and storm surge levels, and push salt water farther inland through ditches and tidal creeks. Natural leaching of salts from soils is expected to decrease as precipitation patterns change to less frequent, but more intense storms, and longer periods of drought. Working land profitability using traditional management practices is expected to decline with increasing soil salinity.[60]

G. Conclusion

As demonstrated throughout this section, the threats to agricultural production, and by extension to our food system because of climate change are significant, with some already being realized. The impact will increase, even under the most optimistic scenarios.

---

[56] Taryn A. Sudol et al., *Resisting-Accepting-Directing Sea Level Rise on the Chesapeake Bay: Agricultural Producers' Motivations and Actions,* 332 J. ENVTL MGMT. (2023).

[57] *Minimizing the Impacts of Saltwater Flooding on Farmland in the Eastern U.S.,* NORTHEAST CLIMATE HUB, U.S. DEP'T OF AGRIC., https://www.climatehubs.usda.gov/hubs/northeast/topic/minimizing-impacts-saltwater-flooding-farmland-eastern-us (last visited Mar. 29, 2023).

[58] *Saltwater Intrusion and Salinization on Coastal Forests and Farms,* SOUTHEAST CLIMATE HUB, U.S. DEP'T OF AGRIC., https://www.climatehubs.usda.gov/hubs/southeast/topic/saltwater-intrusion-and-salinization-coastal-forests-and-farms (last visited Mar. 29, 2023).

[59] *Id.*

[60] *Id.*

This creates an urgent need to address climate change but also demands a consideration of ways to mitigate the impact on our food system in an altered world. How do we address the challenges of "hunger, nutrition, and health" in an environment changed by climate change? The next section of this article explores another vulnerability that puts our food system at risk.

II. Food System Vulnerabilities

There are many ways in which current agricultural production and hence, our food system, lack resilience. It's dependence on monocultural production, limited genetic breeds, fossil-fuel based fertilizers and pesticides, and a lack of care for the soil as a vital natural resource are examples. Concentrated and industrialized production, a hallmark of the U.S. food system, offers certain efficiencies but carries much risk. Farmers of a generation ago recognized that diversified production was the best risk protection strategy, yet modern agriculture largely rejected that model for concentrated, specialized production that arguably now leaves us more vulnerable.

In addition to general concerns about the structure of U.S. agriculture, much of the U.S. domestic food supply is produced in areas that are particularly vulnerable to the impacts of climate change. A significant portion of U.S. food production is concentrated on large operations in the southwest, including California, a region that is experiencing a drought of historic proportions and that is already suffering the effects of climate change. This dependency on one of our most successful, but also most vulnerable regions for our food security puts our food system and our nation at risk.

A. The Vulnerability of Geography: California and the Southwest States

California leads the nation in the production of over fifty major food crops including many fruits and vegetables, nuts, and

dairy products (milk).[61] California farmers produce 99-100% of all our almonds, artichokes, celery, garlic, grapes for raisins, kiwifruit, honeydew melons, nectarines, olives, clingstone peaches, pistachios, plums, and walnuts.[62] While some of this production is practically limited to California because of its climate, other crops have shifted from other regions because of market forces, consolidation of production, and a belief in the efficiency of concentrated production. Year-round production is available for many crops, a decided financial advantage over states with harsh winters.

USDA NASS reports that there were 1.2 million areas of vegetables grown in California in 2017, the "largest total acreage for both fresh market and processing vegetables" and 42% of U.S. vegetable sales.[63] NASS Highlights note that "[f]our of the top five U.S. counties in vegetables sales are in California, with Monterey County accounting for 14 percent of the U.S. total (one third of California's). With $2.8 billion in vegetable sales, Monterey County had more vegetable sales than any state except California.[64]

The U.S. currently depends on California and the Southwest for much of the healthy food that we eat. Arizona is also a major source for our nation's vegetables, ranking second in the nation for the production of lettuce (head, leaf and romaine), cantaloupe and spinach.[65] Approximately, ninety percent of leafy green production in the U.S. is in California and Arizona.[66]

In 2015, The Southwest Regional Climate Hub Assessment considered the impact of climate change on the southwest region. It noted:

---

[61] *California Agricultural Statistics Review 2021-22*, CAL. DEP'T OF FOOD & AGRIC., 7 (2022), https://www.cdfa.ca.gov/Statistics/PDFs/2022_Ag_Stats_Review.pdf.
[62] *Id.*
[63] *2017 Census of Agriculture: Vegetable Production,* U.S. DEP'T OF AGRIC., NAT'L AGRIC. STAT. SERV., https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Vegetable_Production.pdf (last visited Mar. 30, 2023).
[64] *Id.*
[65] *Vegetable Crops*, ARIZ. DEP'T OF AGRIC., https://agriculture.az.gov/plantsproduce/what-we-grow/vegetable-crops (last visited March 30, 2023).
[66] Ashley Kerna et al., *Arizona Leafy Greens: Economic Contributions of the Industry Cluster*, AGRIC. & RES. ECON, UNIV. OF ARIZ COLL. OF AGRIC. & LIFE SCI. (2017), https://economics.arizona.edu/arizona-leafy-greens-economic-contributions-industry-cluster.

> Southwestern agriculture is defined by water availability. More than 92 percent of the region's cropland is irrigated, and although the amount of water used varies regionally, agriculture accounts for 79 percent of all water withdrawals in the region. Future water availability depends on the annual distribution of precipitation, the proportion of winter precipitation falling as snow, groundwater resources, and changing urban and agricultural demands for water. . . Water availability may drive transformational shifts. . . Rising temperatures and shifting precipitation patterns, especially in the southern portion of the region, will alter crop-water requirements, crop-water availability, crop productivity, and costs of water access. Higher temperatures will increase losses from both evaporation and transpiration. Detrimental effects on crop health will in turn drive changes in cropland allocations and production systems.[67]

This report warned of many of the direct impacts of climate change noted in the prior section, including reduced yield and/or quality of some crops, some crops may no longer be viable, additional problems with pests.[68]

In 2018, the Fourth National Climate Assessment noted this stark warning as one of its key messages:

> Food production in the Southwest is vulnerable to water shortages. Increased drought, heat waves, and reduction of winter chill hours can harm crops and livestock; exacerbate competition for water among agriculture, energy generation, and municipal uses; and increase future food insecurity.[69]

Insufficient water increases the vulnerability of agriculture in the southwest and western states. The Bureau of Reclamation reports that it provides irrigation water for Western farmers that produce

---

[67] *2015 Southwest Regional Climate Assessment, supra* note 18 at 13.
[68] *Id.* at 14.
[69] 2018: IMPACTS, RISKS, AND ADAPTATION IN THE UNITED STATES: FOURTH NATIONAL CLIMATE ASSESSMENT, Vol. II, Chapter 25, Southwest, U.S. GLOB. CHANGE RSCH. PROGRAM, https://nca2018.globalchange.gov/chapter/25/ (last viewed Apr. 3, 2023).

60% of our nation's vegetables and 25% of its fresh fruit and nut crops.[70] This water source is rapidly diminishing due to warmer, drier weather and reduced precipitation associated with climate change.[71] This presents a looming crisis for our food system.

U.S. consumers can be grateful to farmers in the Southwest for the abundance of their production. However, it is imperative that we acknowledge that it is inevitable that this production will be disrupted and diminished as a result of climate change. Actions must be taken now to minimize the impact of that disruption, protecting our food supply while easing the transition for those farmers communities affected.

Market forces are already leading to change, but market change typically occurs in response to disruption rather than in anticipation. Agriculture, which is land-based and capital intensive cannot shift locations easily or quickly. Current policies that compensate farmers for losses actually worsen the problem because they distort the market influence.

The World Wildlife Funds' Market Institute found the "growing uncertainty in domestic food production as the climate changes as an urgent challenge of our time."

> . . .California's warming climate makes farming there less certain in the future, and the state will likely suffer from more chronic weather (e.g., increased droughts) as well as severe weather (e.g., heavy rains, flooding and freezes) in the future. Fires, while not especially important for annual crops, can pose serious threats to perennials and tree crops as well as infrastructure. The Sierra Nevada mountains are getting less average snowfall and coupled with warmer springs, this is leading to a faster melt and a lack of water by late summer for the third and fourth production cycles of many crops. This is also devastating for California's orchards since it can mean the loss of large trees due

[70] *About US Fact Sheet*, U.S. BUREAU OF RECLAMATION (Feb. 23, 2023), https://www.usbr.gov/main/about/fact.html.

[71] *Climate Change Contributed To Some of 2020's Worst Weather*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Dec. 15, 2021) (reinforcing the consensus that " humans have created a new climate") https://www.noaa.gov/news-release/report-climate-change-contributed-to-some-of-2020s-worst-weather.

> to water stress as opposed to a single planting of row crops. Over time, it is likely that farmers will have to become very efficient to maintain production and, even so, the state will need to decide which crops are going to receive the available water.[72]

The seriousness of this threat is compounded because many of the types of crops grown in the vulnerable southwest region are our most healthy food crops - vegetables, nuts, and fruits. While some of some of these food crops can only be grown in warm, dry climate of the southwest, many can be grown elsewhere. Much of the prime farmland in the Midwest and Plains is now devoted to corn and soybeans that are used for non-human food purposes including ethanol and livestock feed. Because of the investment in equipment, expertise, infrastructure, and processing facilities, and because of consistent government subsidies that favor these commodity crops, any effort to reinvigorate regional food production outside of the southwest will require planning, government incentives, and time.

B. The Vulnerability of Concentration

Recent examples of food production disruptions unrelated to climate change have given consumers a sense of what food shortages feel like and have showcased the dangers of concentrated food production. Each example is tied to a concentrated, consolidated industry and a marketplace that lacks resilience.

- During the peak of the COVID pandemic, when workers in meat processing plants fell ill, production slowed and was briefly halted in our highly concentrated meat and poultry processing facilities. While this did not lead to any shortages, it did back up the supply chain and leave farmers with no place to bring their market-ready animals for slaughter. Hundreds of thousands of healthy animals were "depopulated," i.e., killed, often suffering a cruel death through over-heating when the

[72]Julia Kurnik, *The Next California*, WORLD WILDLIFE FUND (2020), https://c402277.ssl.cf1.rackcdn.com/publications/1306/files/original/The_Next_California_Phase_1_Report_02-27-20.pdf?1582813424.

ventilation system of a concentrated farm facility was shut down.[73] The meat and poultry industries are highly concentrated, with few slaughter options for livestock and poultry producers.[74]

- The closure of the Abbott manufacturing plant in Sturgis, Michigan for serious food safety violations triggered a nationwide shortage of infant formula. The industry is dominated by four major manufacturers, so the shutdown of the plant in Michigan seriously reduced supply. At one point, it was reported that 43 percent of formula was "out of stock nationwide."[75]
- Concerns about the spread of avian flu led to killing of 43 million egg-laying chickens potentially exposed to the disease, reducing the supply of eggs and sending prices up to record levels in 2022.[76]

These instances give us a glimpse into the future, as disruptions associated with climate change events are almost certain impact our food supply. They can be sudden and unexpected, such as from an extreme weather event, or gradual as in crop losses due to lack of winter chilling or pollination problems. In 2019, a fire at one Kansas meat processing plant sent ripple effects across the cattle industry.[77] What happens when a super cell tornado strikes a major meat processing facility? Or drought impacts all the wheat producing states of the northern plains. By focusing on the recognized

---

[73] *See*, Laura Reiley, *In One Month, the Meat Industry's Supply Chain Broke. Here's What You Need to Know*, WASH. POST. (Apr. 28, 2020). For a startling look at the depopulation process, see, Jamie McLaughlin, *Not Humane, Not AVMA Approved and Definitely Not Euthanasia: Welfare and Efficiency Issues of Swine Depopulation by Ventilator Shutdown*, 27 DRAKE J. OF AGRIC. L. 159 (2022).

[74] Claire Kelloway & Sarah Miller, *Food and Power: Addressing Monopolization in America's Food System*, OPEN MKTS INST., 3-5 (Mar. 2019), https://static1.squarespace.com/static/5e449c8c3ef68d752f3e70dc/t/5ea9fa6c2c1e9c460038ec5b/1588198002769/190322_MonopolyFoodReport-v7.pdf.

[75] Hassan z. Sheikh et al., *Infant Formula Shortage: FDA Regulation and Federal Response*, CONG. RES. SERV. (May 21, 2022), https://crsreports.congress.gov/product/pdf/IF/IF12123.

[76] *Avian Influenza Outbreaks Reduced Egg Production, Driving Prices to Record Highs In 2022*, U.S. DEP'T OF AGRIC, ECON. RSCH. SERV., https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=105576 (last visited Apr. 3, 2023).

[77] Michael Nepveux, *Impacts of the Packing Plant Fire in Kansas*, FARM BUREAU (Sept. 10, 2019) https://www.fb.org/market-intel/impacts-of-the-packing-plant-fire-in-kansas.

efficiencies of concentrated production, we have created vulnerabilities that we tend to ignore until a problem comes up. Suddenly, we are shocked, and the myth of unlimited abundance is shattered.

III. A Radical Realignment of Farm and Food

Because of the bounty of our land and water resources, the U.S. has never had to develop a true food security initiative. The U.S. lacks coordinated federal policies to protect domestic food production and the resilience of our food system. The U.S. has farm policy but not food policy. Climate change imposes a new reality.

While many countries across the world have struggled with basic food security, the U.S. has largely viewed food security as a problem of poverty, affordability, and access. The bounties of U.S. natural resources have created problems of over-production rather than concerns of whether adequate food was available.[78] Policies have been developed around an American myth of unlimited agricultural abundance. Debunking that myth and preparing for a future that depends on resilient food systems may be greatest the policy challenge of our time.

Since the Great Depression and the Dust Bowl, the federal government has influenced our food system through farm programs that provide financial support to farmers. Since that time, approximately every five years, Congress adopts a Farm Bill, providing programs that support agricultural production by providing financial assistance to farmers. This assistance has primarily been tied to commodity crops and/or it has been linked to environmental practices.[79] While this support is frequently justified as supporting food production under the mantra of "feed the world," it only does so indirectly, and in fact, much of the support goes to

[78] Allen H. Olson, *Federal Farm Programs – Past, Present and Future—Will We Learn from our Mistakes?,* 6 GREAT PLAINS NATURAL RESOURCES J. 1, 2-14 (2001) (providing an excellent history of federal farm programs and the recurring concern of farm surpluses).
[79] *Id.*

non-food crops such as crops grown for biofuel or for livestock feed and cotton.[80]

For example, the U.S. is the largest producer of corn in the world, with U.S. farmers planting about 90 million acres of corn each year, the majority of which is grown in the Heartland region.[81] Iowa and Illinois alone account for almost one-third of this production.[82] Forty-five percent of this production is used to create ethanol; another forty percent is used as livestock feed.[83] Corn farmers receive significant financial support through farm bill programs. They are aided by crop insurance protections that protect both physical loss and revenue loss. And they receive further financial support through the Department of Energy's biofuels program and the Renewable Fuel Standards. These are strong government incentives for farmers to plant as much corn as possible, with food crops as a far less lucrative or secure crop to produce.

Farm programs support farmers but not food. The farm safety net that is established through the farm programs in the farm bill are designed to protect the livelihoods of American farmers. That may well be a noble goal, but it should not be confused with policies that promote food security. For example, when a disaster occurs, the farmer is likely to receive support through crop or livestock insurance or direct disaster assistance. Even farm workers are left out of the protection scheme.[84] There is no safety net for consumers; no mechanism whatsoever for addressing the disaster's impact on our food supply or food system.

Nutrition assistance programs such as the Supplemental Nutrition Assistance Program (SNAP) and the Women's, Infants, and Children program (WIC) support individuals and families in need, under the assumption that food is available but not affordable. The infant formula shortage revealed the fallacy in that assumption

---

[80] Susan A. Schneider, *A Reconsideration of Agricultural Law: A Call for the Law of Food, Farming, and Sustainability*, 34 WM & MARY J. ENVTL. L. & POL'Y REV. 935, 949 (2010).

[81] *Feed Grains Sector at a Glance*, U.S. DEP'T OF AGRIC. ECON. RSCH. SERV., https://www.ers.usda.gov/topics/crops/corn-and-other-feed-grains/feed-grains-sector-at-a-glance/.

[82] *Id.*

[83] *Id.*

[84] For a critical analysis of agricultural policy regarding farmworkers, see Jessica Guarino, *The Injustices of Agricultural Exceptionalism: A History and Policy of Erasure*, 27 DRAKE J. OF AGRIC. L. 321 (2022) (examining the embedded oppression of farmworkers throughout U.S. agricultural history).

and showcased a significant gap in food security.[85] In Congressional testimony in March 2023, Frank Yiannas, FDA's former Deputy Commissioner for Food Policy and Response stated that "The nation remains one outbreak, one tornado, flood or cyber-attack away from finding itself in a similar place."[86]

Exacerbating the urgency of the situation, the challenges faced by farmers in the U.S. will be faced by farmers across the world. Indeed, projections are that countries in the middle latitudes will be more greatly impacted than the U.S. "A general rule of thumb in the equatorial tropics is that every 1°C rise in mean temperature is associated with a 10 percent drop in crop yields. Temperature spikes during critical phases of a plant's growth can lead to outright crop failure."[87] Food security will be a global concern.

A radical realignment in the way we think about farm and food policy is required. This begins with a recognition that they myth of unlimited agricultural abundance as applied to our ability to produce food is just that – a myth. We must "understand and agree to the proposition that there is 'this much and no more'"[88] and use our resources wisely.

What would be the principles that underlie a U.S. food policy? They are simple, common-sense principles. It is both frustrating and oddly reassuring, that most of these principles have been proposed by this author and by many other agricultural and food law scholars over the last two decades. They have been proposed in one form or another to promote food democracy, to increase resilience, to promote rural economies, to connect consumers to their food source, to promote food justice, to protect the environment and to promote resilience. The difference is that now they are proposed with new urgency as climate change threatens our food security. Before, there was the argument that we should pursue a new direction

---

[85] Martine Paris, *Why the Baby Formula Shortage Continues in the U.S.,* WASH. POST (July 15, 2022).

[86] Helena Bottemiller, *The National Security Risks We Don't Think About*, FOODFIX, (Mar. 31, 2023) https://foodfix.co/the-national-security-risks-we-dont-think-about/.

[87] Sova *supra* note 29.

[88] Wendell Berry, *The Agrarian Standard*, ORION MAGAZINE (2020), https://orionmagazine.org/article/the-agrarian-standard/ (describing the principal of agrarianism and stating, "Everything that happens on an agrarian farm is determined or conditioned by the understanding that there is only so much land, so much water in the cistern, so much hay in the barn, so much corn in the crib, so much firewood in the shed, so much food in the cellar or freezer, so much strength in the back and arms — and no more.").

for farm and food policies, now there is the argument that we must. A radical realignment of our approach to food and agriculture is desperately needed.

Six principles are proposed to guide this realignment.

1) The production of food crops should be prioritized over non-food crops; agricultural policies and agricultural use water rights should favor the production of food. Recognizing that we do not have an unlimited supply of water and that fertile soil is a natural resource that is being depleted should cause policy makers to prioritize the use of both. Food, being essential to life, has to be our priority.

2) Soil and water, including groundwater should be recognized as limited resources required for our national security. As such, they should be protected. In his recent book, THE LAND REMAINS: A MIDWESTERN PERSPECTIVE ON OUR PAST AND OUR FUTURE, agricultural scholar Neil Hamilton makes a compelling case for the importance of assuring soil health and conserving agricultural land.[89] Agricultural lawyers and scholars, Allen Olson and Edward Peterson argue that soil erosion and water availability are among the greatest threats to future agricultural production.[90] A recent report suggests that worldwide "soil is eroding 10 to 100 times faster than it is being formed, a process accelerated by climate change impacts like drought and high-intensity rainfall."[91] Legally, soil is recognized primarily as connected to the land, with property rights associated with the land. While it is not the intent of this article to challenge property law or the rights of property owners, given the connection between soil and food production, it is in our national interest to consider ways to preserve soil quality through either incentives or reasonable regulation.

Similarly, while an analysis of water law, typically a matter of state law, is beyond the scope of this article, it is important to recognize that at this time, there is no priority established for food

---

[89] *See generally*, Neil D. Hamilton, THE LAND REMAINS: A MIDWESTERN PERSPECTIVE ON OUR PAST AND FUTURE (2022) (examining farm policy through the lens of the land on which we depend and promoting positive solutions to protect the soil).

[90] Allen H. Olson & Edward J. Peterson, *Pandemic, Climate Change, Farm Subsidies*, 17 J. FOOD L. & POL'Y 36, 43 (2021).

[91] Sova *supra* note 29 (citing a report issued by the Intergovernmental Panel for Climate Control (IPCC)).

crops. Even as communities battle farmers and states battle each other in the Colorado River watershed, there is no priority of usage within agriculture. Food security depends primarily on soil and water; it is imperative that we protect them.

3) Farm policy should coordinate and be consistent with nutrition policy; the crops that are incentivized should be the same crops that Americans are encouraged to consume. Federal support to agriculture has long been criticized for having a negative impact on diet and nutrition. Marion Nestle, a leading nutrition researcher and author noted the "serious disconnect between agriculture and health policy" in the U.S.[92] The farm programs' focus on commodity crops has led to the massive production of feed grains, providing cheap livestock feed and low-cost ingredients for processed and ultra-processed ingredients. U.S. farm programs have never encouraged "specialty crops,"[93] and over time the farm programs have discouraged the production of healthy crops such as fruits and vegetables.[94] The impact of these farm programs is to keep the price of commodity crops low for food manufacturers, pricing that has been instrumental to the proliferation of processed and ultra-processed foods.[95]

Domestic food production has been inconsistent with the dietary guidance recommendations released by the USDA and U.S. Department of Health and Human Services for decades.[96]

---

[92] Tracie McMillan, *The U.S. Doesn't Have Enough of The Vegetables We're Supposed to Eat*, THE SALT, NAT'L PUB. RADIO (Sept. 19, 2015) https://www.npr.org/sections/thesalt/2015/09/19/441494432/the-u-s-doesnt-have-enough-of-the-vegetables-were-supposed-to-eat, (quoting Marion Nestle and noting that "while Americans are told to eat fruits and vegetables for their health, the government has meanwhile mostly just subsidized other crops that end up in cheaper, less healthy processed food").

[93] "Specialty crops are defined in law as fruits and vegetables, tree nuts, dried fruits and horticulture and nursery crops including floriculture." *USDA Definition of Specialty Crop*, U.S. DEP'T OF AGRIC., AGRIC. MKT. SERV. https://www.ams.usda.gov/sites/default/files/media/USDASpecialtyCropDefinition.pdf (last visited Apr. 3, 2023).

[94] Schneider *supra* note 80 at 948-49.

[95] *Id.*

[96] The Dietary Guidelines for Americans are issued by the USDA and the U.S. Department of Health and Human Services each five years pursuant to a mandate included in the 1990 National Nutrition Monitoring and Related Research Act, Pub. L. 101-445 §301, 104 Stat. 1034, 1042 (Oct. 22, 1990) (codified at 7 U.S.C. § 5341).

[96] *From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste*, ENVTL PROT. AGENCY, ii (Nov. 2021), https://www.epa.gov/system/files/documents/2021-

> Although meats and total grains were supplied generally in recommended proportions, total vegetables, total fruit, whole fruit, and milk were supplied in suboptimal proportions that changed very little over time. Saturated fat, sodium, and calories from solid fat, alcoholic beverages, and added sugars were supplied in varying degrees of unhealthy abundance over the years. Supplies of dark-green/orange vegetables and legumes and whole grains were entirely insufficient relative to recommendations, with virtually no change over time. [97]

Climate change provides the imperative to revisit this conflict. To assure nutritional security, farm policy should incentivize the production of the same foods that are encouraged by health professionals through the dietary guidance.

4) Regional food systems supporting the production of healthy foods should be established across the country, minimizing risk of loss to extreme weather events. For decades, food policy advocates have argued for that regional food systems were key to revitalizing rural communities, re-connecting consumers to their food source, and supporting local farmers. Climate change now makes this imperative as a risk-management strategy. Support for "local food" has been a part of USDA's ongoing activities for some time and was enhanced by the Local Agriculture Market Program (LAMP) enacted as part of the 2018 Farm Bill.[98] The USDA has also promised significant funding for local and regional food systems as part of its Transforming the Food System Initiative.[99] The USDA can be commended for these investments.

5) Food production research should be promoted, including research into more sustainable indoor production

---

11/from-farm-to-kitchen-the-environmental-impacts-of-u.s.-food-waste_508-tagged.pdf.

[97] Susan M. Krebs-Smith et al., *Healthfulness of the U.S. Food Supply*, 38 AMERICAN JOURNAL OF PREVENTATIVE MEDICINE 472 (May 2010), https://www.ajpmonline.org/article/S0749-3797(10)00085-1/fulltext.

[98] 7 U.S.C. § 1627c (2022).

[99] Press Release, *USDA Announces Framework for Shoring Up the Food Supply Chain and Transforming the Food System to Be Fairer, More Competitive, More Resilient*, U.S. DEP'T OF AGRIC. (June 1, 2022), https://www.usda.gov/media/press-releases/2022/06/01/usda-announces-framework-shoring-food-supply-chain-and-transforming.

methods, the development of new varieties of fruits and vegetables that are resilient and adapted to climate change conditions, and new technologies such as cell-culturing and fermentation. While research and technology are essential tools for mitigating the impact of climate change on food security, there is not a technology fix to address climate change and food security. Rather, combined efforts that include technology must be coordinated to mitigate its effects.

6) Americans need a culture of respect and appreciation for the importance of healthy food. This culture would result in a closer connection to food sources, more interest in food, better eating habits, better health and the reduction of food waste. We currently waste approximately thirty-five percent of the food produced in the U.S., with about half of this waste lost at the consumption stage at home or in restaurants.[100] This wasted food contains "enough calories to feed more than 150 million people each year."[101] It is also a waste of all the resources that went into its production, transportation, and marketing. Decaying food is a significant contributor of greenhouse gas emissions.[102] A culture of food appreciation, reflected in schools, local communities, and throughout government would alleviate this problem.

The 2021 White House Conference on Hunger, Nutrition and Health began an important discussion about food security and has elevated the issue into greater prominence in policy discussions. As Chef Jose Andres, one of the leaders at the conference has been quoted as saying, "Food is national security. Food is craft. Food is everything, when you think about it."[103] We must build a culture that recognizes this.

---

[100] *From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste supra* note 96.
[101] *Id.*
[102] *Id.*
[103] *Changing the World Through the Power of Food: A Thanksgiving Address by Chef Jose Andres*, THE RICHMOND FORUM (Nov. 2021), https://richmondforum.org/programs/power-of-food/ (providing quotes from Chef Andres).

IV. Conclusion

The purpose of this article is to accelerate a difficult conversation. Many of the problems within our food system that are referenced here have been raised before by this author[104] and by many others.[105] Climate change increases the stakes and raises the urgency. While our food security may not seem under threat now - most Americans have access to sufficient food if they can afford it today – climate change and its impacts are progressing more quickly than researchers have feared. As the authors of the United Nations report issued in March 2023 stated, "There is a rapidly closing window of opportunity to secure a liveable and sustainable future for all."[106] This call to action applies to not only efforts to reduce greenhouse gasses, it applies to efforts to adjust to the world that we have created.

The changes needed to prepare for food security challenges are significant and they will take time. The answers that are proposed may seem straightforward, but they reflect a radical realignment of farm and food policy that will bring economic pain to some and opportunities to others. Time is needed for the transition.

The issues raised in this article should have impacted our policies decades ago. Had they done so, we would have had more time for a smooth transition. For decades, we have largely ignored the risks of climate change and exhausted natural resources, relying on the myth of unlimited agricultural abundance. We still have a chance to correct course and recognize the true value of food and the risks we have created. Will we take it?

---

[104] Schneider, *supra* note 80, at 963.

[105] Hamilton, *supra* note 89; Olson & Peterson, *supra* note 90; Nicole Civita, *Agrarians Feeding Communities: Reconnecting Federal Farm Policy & Nutrition Assistance for a More Just Agri-Food System*, 7 NW INTERDISC. L. REV. 1 (2014) (examining the problems with past and current farm policy and proposing a responsible reconciliation of producer and consumer interests as the new direction).

[106] Hoesung Lee et al., *Climate Change 2023: Synthesis Report of the IPCC Sixth Assessment Report (AR6), Summary for Policymakers*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), UNITED NATIONS, 25 (Mar. 2023).