## Food as You Know it is About to Change by David Wallace Wells

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Part of What to Eat on a Burning Planet, a series exploring bold ideas to secure our food supply. Read more about this project in a <u>note</u> from Eliza Barclay, Opinion's climate editor.

From the vantage of the American supermarket aisle, the modern food system looks like a kind of miracle. Everything has been carefully cultivated for taste and convenience even those foods billed as organic or heirloom — and produce regarded as exotic luxuries just a few generations ago now seems more like staples, available on demand: avocados, mangoes, out-of-season blueberries imported from Uruguay.

But the supermarket is also increasingly a diorama of the fragility of a system — disrupted in recent years by the pandemic, conflict and, increasingly, climate change. What comes next? Almost certainly, more disruptions and more hazards, enough to remake the whole future of food.

The world as a whole is already facing what the Cornell agricultural economist Chris Barrett calls a "food polycrisis." Over the past decade, he says, what had long been reliable global patterns of year-on-year improvements in hunger first stalled and then reversed. Rates of undernourishment have grown <u>21 percent</u>since 2017. Agricultural yields are still growing, but not as quickly as they used to and not as quickly as demand is booming. Obesity has continued to rise, and the average micronutrient content of dozens of popular vegetables has continued to <u>fall</u>. The food system is contributing to the growing burden of diabetes and heart disease and to new spillovers of infectious diseases from animals to humans as well.

And then there are prices. Worldwide, wholesale food prices, adjusted for inflation, have grown about 50 percent since 1999, and those prices have also grown considerably more volatile, making not just markets but the whole agricultural Rube Goldberg network less reliable. Overall, American grocery prices have grown by almost <u>21 percent</u> since President Biden took office, a phenomenon central to the widespread perception that the cost of living has exploded on his watch. Between 2020 and 2023, the wholesale price of olive oil <u>tripled</u>; the price of cocoa delivered to American ports jumped by <u>even more</u> in less than two years. The economist Isabella Weber has <u>proposed</u> maintaining the food equivalent of a strategic petroleum reserve, to buffer against shortages and ease inevitable bursts of market chaos.

Price spikes are like seismographs for the food system, registering much larger drama elsewhere — and sometimes suggesting more tectonic changes underway as well. More than three-quarters of the population of Africa, which has already surpassed one billion, cannot today afford a healthy diet; this is where most of our global population growth is expected to happen this century, and there has been little agricultural productivity growth there for 20 years. Over the same time period, there hasn't been much growth in the United States either.

Though American agriculture as a whole produces massive profits, Mr. Barrett says, most of the country's farms actually lose money, and around the world, food scarcity is driving record levels of human displacement and migration. According to the World Food Program, 282 million people in 59 countries went hungry last year, 24 million more than the previous year. And already, Mr. Barrett says, building from research by his Cornell colleague Ariel Ortiz-Bobea, the effects of climate change have <u>reduced</u> the growth of overall global agricultural productivity by between 30 and 35 percent. The climate threats to come loom even larger.

It can be tempting, in an age of apocalyptic imagination, to picture the most dire future climate scenarios: not just yield declines but mass crop failures, not just price spikes but food shortages, not just worsening hunger but mass famine. In a much hotter world, those will indeed become likelier, particularly if agricultural innovation fails to keep pace with climate change; over a 30-year time horizon, the insurer Lloyd's <u>recently</u> <u>estimated</u> a 50 percent chance of what it called a "major" global food shock. But disruption is only half the story and perhaps much less than that. Adaptation and innovation will transform the global food supply, too. At least to some degree, crops such as avocados or cocoa, which now regularly <u>appear on lists</u> of climate-endangered foodstuffs, will be replaced or redesigned. Diets will shift, and with them the farmland currently producing staple crops — corn, wheat, soy, rice. The pressure on the present food system is not a sign that it will necessarily fail, only that it must change. Even if that progress does come to pass, securing a stable and bountiful future for food on a much warmer planet, what will it all actually look like?

How climate change could transform yields of two major crops Projected change in corn and wheat yields in 2050, based on an upper-middle scenario for global warming.



+40% or more Corn production in 2050

China is the world's second-largest

producer of corn, but yields are projected to decrease across most of the country. Drought conditions have already led Mexico to import a record amount of corn in recent years. Climate change could further decrease its yields. Rising temperatures could make the highlands of Peru

a more productive area for corn.

## Wheat production in 2050

The U.S., one of the largest exporters of wheat, could see increased yields, especially in more northern latitudes.

Pakistan, where wheat accounts for nearly two-thirds of all calories consumed, could see sharp declines.

Graphic by Aileen Clarke

Over the past few years, as the world has begun a belated sprint toward renewable energy sources, we've gotten a pretty clear picture of what is often called the energy transition — clean power, primarily from wind and solar, that will be so cheap and abundant that the dirty old sources can't possibly compete.

It is considerably harder to picture the equivalent for the food system: a proper food transition, delivering better nutrition more equitably and more affordably to more people, all without devastating ecosystems or polluting local environments or pushing the planet further into climate disarray.

Partly this is a matter of sheer scale. More than <u>half</u> of America's land is used for agricultural production.

Outside the United States, the patterns <u>are similar</u>: More than one-third of the planet's land is used to produce food, and 70 percent of all fresh water is used to irrigate farmland. Pacing the supermarket aisle, you might think that whatever you're buying for lunch or dinner is produced out there somewhere on the periphery of modern life. But globally, the <u>equivalent</u> of South America is now used to grow crops, and the equivalent of Africa is used to graze animals. Combined, this is more of the world's surface than is occupied by forests and more than 10 times as much land as is occupied by all human settlement. And according to the World Resources Institute, we may need to add <u>almost two Indias</u> to the world's existing farmland to meet food needs in the second half of this century. — but adding that farmland means cutting down forests, which store carbon, in order to graze more animals, which produce carbon.

This all makes it a pretty unwieldy system to reimagine root and branch, and yet some fundamental changes are necessary, given not only climate's impending impact on food but food's ongoing impact on climate. One estimate is that food production is directly responsible for nearly a quarter of all global carbon emissions. Add indirect emissions, Project Drawdown's Jonathan Foley <u>notes</u>, and agriculture is responsible for one-third of the global total of emissions. If food waste were a country, it would be somewhere around the world's third or fourth biggest emitter of carbon.

A few years ago, it was possible to imagine a suite of solutions that both addressed the problem of emissions from food production and pivoted away from industrial agriculture. In fact, it was somewhat hard to ignore the hype. But a lot of the buzziest approaches have gotten a bit less buzzy with more scrutiny: sequestering carbon in soil <u>looks trickier than</u> advocates expected, and no-till, climate-smart regenerative farming practices now look less like miracle cures, as well. Much-ballyhooed vertical farming has experienced only stunted growth, thanks in part to its <u>astronomical energydemands</u>. And while genetically-modified varietals look perennially promising, they remain unpopular or even illegal in many parts of the world — a Philippines court recently banned nutritionally-enhanced golden rice, a decision that <u>could</u> result in the deaths of many thousands of children from malnutrition and vitamin deficiencies.

We haven't changed our behavior much, either. Scientists routinely publish eye-popping estimates of the impact of a switch to a plant-based diet, which could significantly cut emissions for individuals and, at the global level, provide <u>half of the emissions</u> reductions needed to keep the planet from warming by more than two degrees. But while many assume that vegetarianism and veganism are growing at least in rich parts of the world, those trend lines <u>have been pretty flat</u> for decades now in the U.S. — with per capita consumption of meat both here and in Europe growing dramatically over the last 50 years (more recently, beef has gotten somewhat less popular). And while some still believe that lab-grown and cultured meat represent the future of "animal" proteins, none of the major producers exactly took over the meat market.

This has all been especially dispiriting given the rapid progress made not just in renewable energy, but also with those pieces of the climate puzzle once known as the hard-to-abate sectors: things like steel making, cement production and various other areas of heavy industry and infrastructure for which there are suddenly green alternatives, even just a few years deep into meaningful spending on research and development.

In agriculture, the state of progress is very different. Farming may look intuitively like a climate-friendly undertaking, but it remains a stubborn carbon problem — and now looks increasingly likely to outlast the other, more obvious parts of the decarbonization challenge. We have long conceptualized climate change as an industrial crisis, to be solved through a new and green industrial revolution. But in a few decades, we may find ourselves having solved the industrial problems of warming, only to be confronted instead by a persistent set of challenges that seem pre-modern by comparison — how to extract more calories from less land and how to do so without bankrupting the earth and its soils along the way.

About three-quarters of all global agricultural land is vulnerable to substantial climate disruptions, NASA's Jonas Jägermeyr says, "so mostly everywhere you look, things will change in one way or the other." And that probably means the food you're eating, too.

"The good news is, we've seen this show before — we've faced crises before," says Mr. Barrett. The examples of success he cites are probably familiar: Innovations to solve the challenges of the Dust Bowl in America and later the Green Revolution in Asia allowed hundreds of millions of people to avoid starvation and helped usher in the fastest escape from extreme poverty the world has ever experienced.

Mr. Barrett sees plenty of promise on the horizon now, too: biofortified crops; new techniques to fix nitrogen from the air, limiting the use of fossil-fuel based fertilizer; resilient varieties, like <u>flood-resistan</u>t rice, that are already transforming the paddies of South Asia. But there's no magic-bullet solution, he says: We need a bundle of innovations and <u>interventions</u>.

And innovation at this scale doesn't just happen at the snap of a finger. The seedlings tend to bloom only after a decade or two of scientific, political, social and economic germination (and often difficulty). Even where politics are relatively stable, market incentives are often perverse, infrastructure often insufficient and support systems lacking for smallholder farmers trying to innovate their way toward greater crop stability and abundance.

In the United States, investment in agricultural research and development has fallen by almost a third in this young century, and "the failure to invest in improving agricultural productivity, especially of healthier foods, basically traces to complacency," Mr. Barrett says. All told, he believes that agricultural research and development spending needs to at least triple to keep pace with booming demand.

Mr. Jägermeyr of NASA calls it "the challenge of our generation" — how to save the food system from what he calls a "quadruple squeeze." First, the problem of productivity and hunger. Second, the risk to ecosystems, under threat from fertilizer runoff deforestation and other pollution. Third, the challenge of nutritional deficiency, as those foods we are growing more of are generally getting worse for us over time. And finally climate, which is driving a "fundamental change across most breadbaskets on the planet," he says. "It's pretty complicated," he admits. "And the scary part is that we have to solve them all."