Gates Notes

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How to Avoid a Climate Disaster

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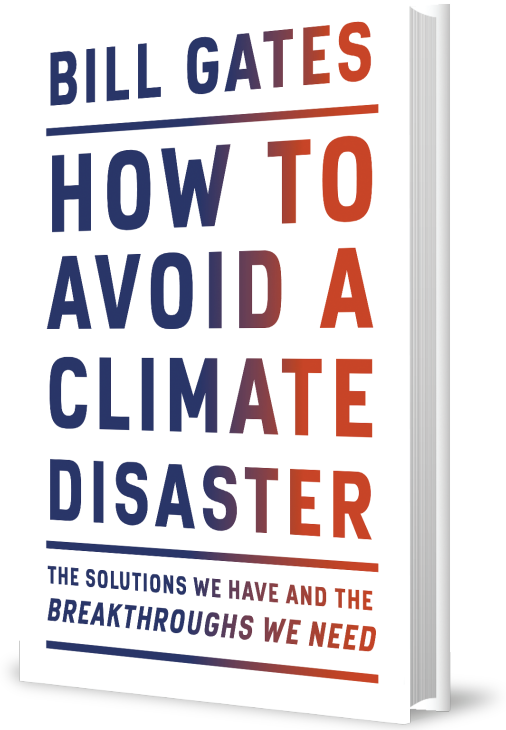


CHAPTER 6
HOW WE GROW THINGS

Cheeseburgers run in my family. When I was a kid, I'd go on hikes with my Boy Scout troop, and all the guys always wanted to ride home with my dad because he'd stop along the way and treat everyone to burgers. Many years later, in the early days of Microsoft, I scarfed down countless lunches, dinners, and late-night meals at the nearby Burgermaster, one of the Seattle area's oldest burger chains.

Eventually, after Microsoft became successful but before Melinda and I started our foundation, my dad started using the Burgermaster near his house as an unofficial office. He'd sit in the restaurant, eating lunch while he sifted through requests we had received from people who were asking for donations. After a while, word got out, and Dad started getting letters addressed to him there: "Bill Gates Sr., in care of Burgermaster."

Those days are long gone. It's been two decades since Dad traded in his table at Burgermaster for a desk at our foundation. And although I still love a good cheeseburger, I don't eat them nearly as often as I used to—because of what I've learned about the impact that beef and other meats have on climate change.

Raising animals for food is a major contributor of greenhouse gas emissions; it ranks as the highest contributor in the sector that experts call "agriculture, forestry, and other land use," which in turn covers a huge range of human activity, from raising animals and growing crops to harvesting trees. This sector also involves a wide range of various greenhouse gases: With agriculture, the main culprit isn't carbon dioxide but methane—which causes 28 times more warming per molecule than carbon dioxide over the course of a century—and nitrous oxide, which causes 265 times more warming.

All told, each year's emissions of methane and nitrous oxide are the equivalent of more than 7 billion tons of carbon dioxide, or more than 80 percent of all the greenhouse gases in this ag/forestry/land use sector. Unless we do something to curb these emissions, that number will go up as we grow enough food to feed a global population that's getting bigger and richer. If we want to get near net-zero emissions, we're going to have to figure out how to grow plants and raise animals while reducing and eventually eliminating greenhouse gases.

And farming isn't the only challenge. We'll also have to do something about deforestation and other uses of land, which together add a net 1.6 billion tons of carbon dioxide to the atmosphere while also destroying essential wildlife habitats.

In keeping with such a wide-ranging subject, this chapter has a bit of everything. I'll tell you about one of my heroes, a Nobel Peace Prize–winning agronomist who saved a billion people from starvation but whose name is largely unknown outside global-development circles. We'll also explore the ins and outs of pig manure and cow burps, the chemistry of ammonia, and whether planting trees helps avoid a climate disaster. But before we get to any of that, let's start with a famous prediction that turned out to be historically wrong.

In 1968, an American biologist named Paul Ehrlich published a best-selling book called *The Population Bomb*, in which he painted a grim picture of the future that was not far removed from the dystopian vision of novels like *The Hunger Games*. "The battle to feed all of humanity is over," Ehrlich wrote. "In the 1970s and 1980s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now." Ehrlich also wrote that "India couldn't possibly feed 200 million more people by 1980."

None of this came to pass. In the time since *The Population Bomb* came out, India's population has grown by more than 800 million people—it's now more than double what it was in 1968—but India produces more than three times as much wheat and rice as it did back then, and its economy has grown by a factor of 50. Farmers in many other countries throughout Asia and South America have seen similar productivity gains.

As a result, even though the global population is growing, there are not hundreds of millions of people starving to death in India or anywhere else. In fact, food is becoming more affordable, not less. In the United States, the average household spends less of its budget today on food than it did 30 years ago, a trend that's being repeated in other parts of the world as well.

I'm not saying that malnutrition isn't a serious problem in some places. It is. In fact, improving nutrition for the world's poorest is a key priority for Melinda and me. But Ehrlich's prediction of mass starvation was wrong. Why? What did Ehrlich and other doomsayers miss?

They didn't factor in the power of innovation. They didn't account for people like Norman Borlaug, the brilliant plant scientist who sparked a revolution in agriculture that led to the gains in India and elsewhere. Borlaug did it by developing varieties of wheat with bigger grains and other characteristics that allowed them to provide much more food per acre of land—what farmers call raising the yield. (Borlaug found that as he made the grains bigger, the wheat couldn't stand up under their weight, so he made the wheat stalks shorter, which is why his varieties are known as semi-dwarf wheat.)

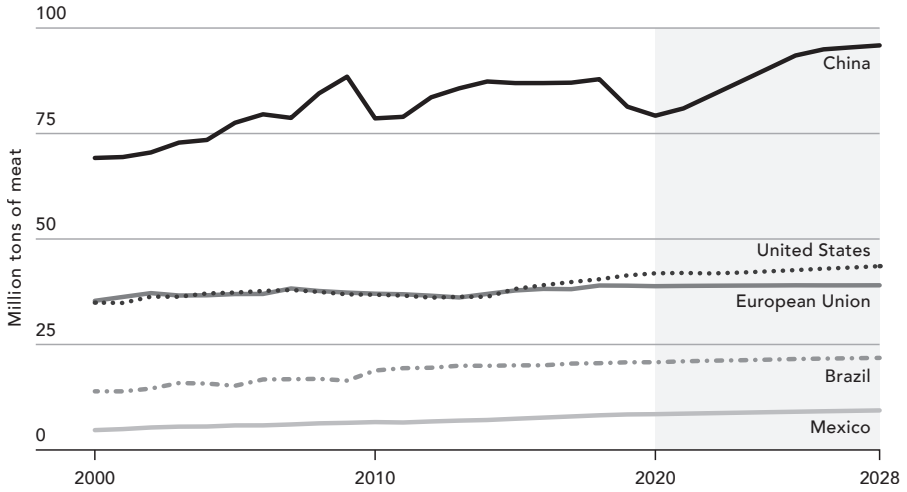
As Borlaug's semi-dwarf wheat spread around the world, and as other breeders did similar work on corn and rice, yields tripled in most areas. Starvation plummeted, and today Borlaug is widely credited with saving a billion lives. He won the Nobel Peace Prize in 1970, and we're still feeling the impact of his work: Virtually all the wheat grown on earth is descended from the plants he bred. (One downside of these new varieties is that they need lots of fertilizer to reach their full growth potential, and as we'll discuss in a later section, fertilizer has some negative side effects.) I love the fact that one of history's greatest heroes had a job title—agronomist—that most of us have never even heard of.

So what does Norman Borlaug have to do with climate change?

The global population is headed toward 10 billion people by 2100, and we're going to need more food to feed everyone. Because we'll have 40 percent more people by the end of the century, it would be natural to think that we'll need 40 percent more food too, but that's not the case. We'll need even more than that.

Here's why: As people get richer, they eat more calories, and in particular they eat more meat and dairy. And producing meat and dairy will require us to grow even more food. A chicken, for example, has to eat two calories' worth of grain to give us one calorie of poultry—that is, you have to feed a chicken twice as many calories as you'll get from the chicken when you eat it. A pig eats three times as many calories as we get when we eat it. For cows, the ratio is highest of all: six calories of feed for every calorie of beef. In other words, the more calories we get from these meat sources, the more plants we need to grow for the meat.

This chart shows you the trends in meat consumption around the world. It's basically flat in the United States, Europe, Brazil, and Mexico, but it's climbing rapidly in China and other developing countries.



Most countries aren't consuming more meat than they used to. China, though, is a big exception. (OECD-FAO Agricultural Outlook 2020)

Here's the conundrum: We need to produce much more food than we do today, but if we keep producing it with the same methods we use now, it will be a disaster for the climate. Assuming we don't make any improvements in the amount of food we get per acre of pasture or cropland, growing enough to feed 10 billion people will drive up food-related emissions by two-thirds.

Another concern: If we make a big push to generate energy from plants, we could accidentally spark a competition for cropland. As I'll describe in chapter 7, advanced biofuels made from things like switchgrass could give us zero-carbon ways to power trucks, ships, and airplanes. But if we grow those crops on land that would otherwise be used to feed a growing population, we could inadvertently drive up food prices, pushing even more people into poverty and malnutrition while accelerating the already dangerous pace of deforestation.

To avoid these traps, we're going to need more Borlaug-sized breakthroughs in the years ahead. Before we can look at what those breakthroughs might be, though, I want to explain where exactly all these emissions are coming from and explore our options for eliminating them using today's technology. Just as I did in the previous chapter, I'll use Green Premiums to show why getting rid of these greenhouse gases is too expensive today, and to make the case that we need some new inventions.

Which brings me to cow burps and pig manure...