required.

by Bill Gates
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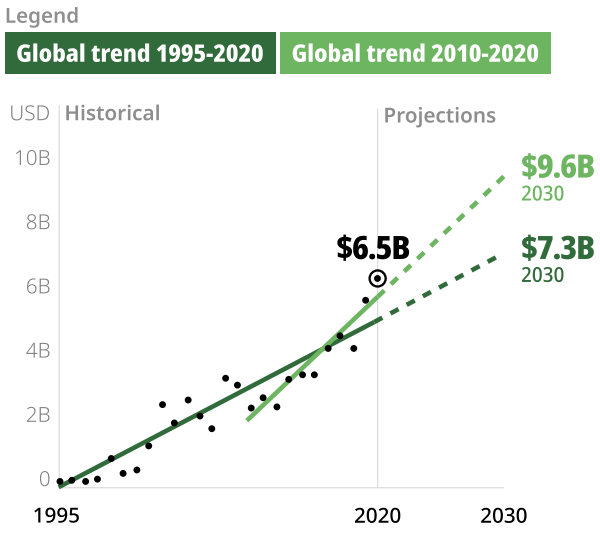
6 min reading time

Ukraine and Russia for half their wheat. Now, those shipments were canceled, and the supply shock spiked the price of replacement wheat to its highest level in 40 years. Prices eventually started falling in May, but in the interim, there were the makings of a modern famine, with world leaders sounding the alarm bell, calling for an influx of aid—money and pallets of food to be shipped to sub-Saharan ports immediately.

Even before the war in Ukraine, food aid had been skyrocketing, and it's projected to keep rising through the end of the decade.

Food aid to low-income countries is at record levels—and rising

Past and projected spending on food aid



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solve the larger problem.

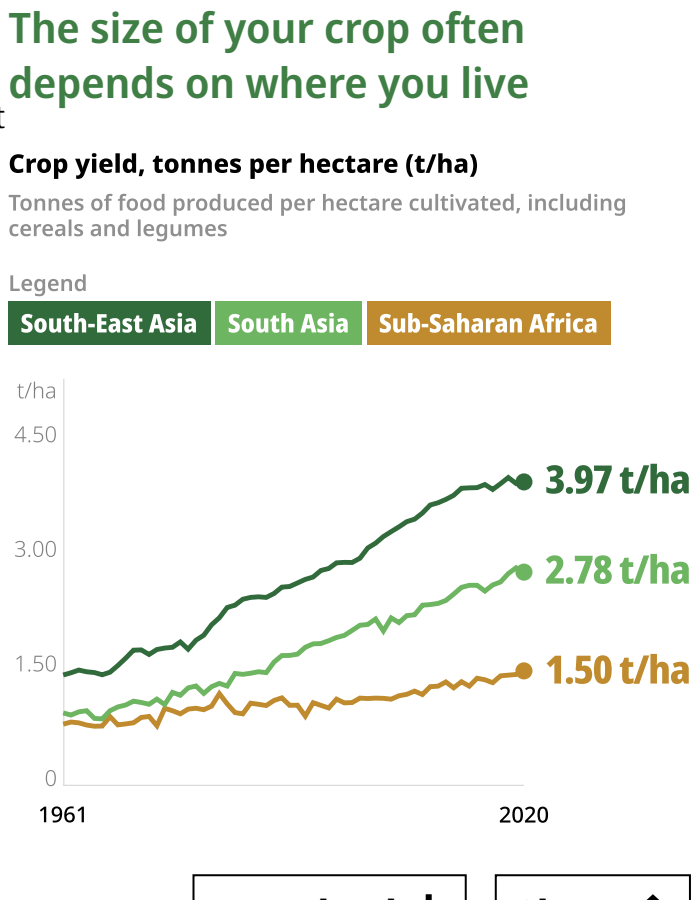
The goal should **not simply be giving *more* food aid**.

It should be to ensure ***no* aid is needed in the first place**.

It's worth stepping back and asking a basic question: *Why did a crisis in Eastern Europe threaten to starve millions of people six thousand miles away?*

It's a complex issue. But mostly, it's a story about where it's easy to produce food—and where it isn't.

Since the 1960s, agricultural productivity has increased all over the world. Farmers saw their harvests get bigger, but they didn't get bigger everywhere at the same rates. In places like China and Brazil, harvests boomed, while productivity in many South-East Asian countries—Laos and Cambodia, for instance—lagged behind the global average. In sub-Saharan Africa, harvests grew much more slowly than those anywhere else in the world—and not nearly fast enough to feed the domestic population.



When a region can't grow enough to feed its people, there's only one solution—to import food—which Africa does on the order of US$23 billion a year.

Each African nation is different, but none is likely buying grain from Eastern Europe

"The goal should not simply be giving more food aid. It should be to ensure no aid is needed in the first place."

—Bill Gates

The low agricultural productivity has everything to do with the conditions in which African farmers labor. Most eke out a living by farming very small plots of land, often less than a hectare (2.4 acres), without enough irrigation or fertilizer, so whenever there's a shock to the wider food system—and the total global supply of food is reduced—they cannot grow enough to make up the deficit. People go hungry. This time, the shock was a war that created a disconnect between Eastern European farms and the global supply chain, but next time it could be a different type of shock, like a drought or heat wave that wipes out entire farms across Africa. In fact, that's the more likely scenario.

production since the invention of agriculture, especially in Africa where the environment is deteriorating faster than anywhere on Earth.

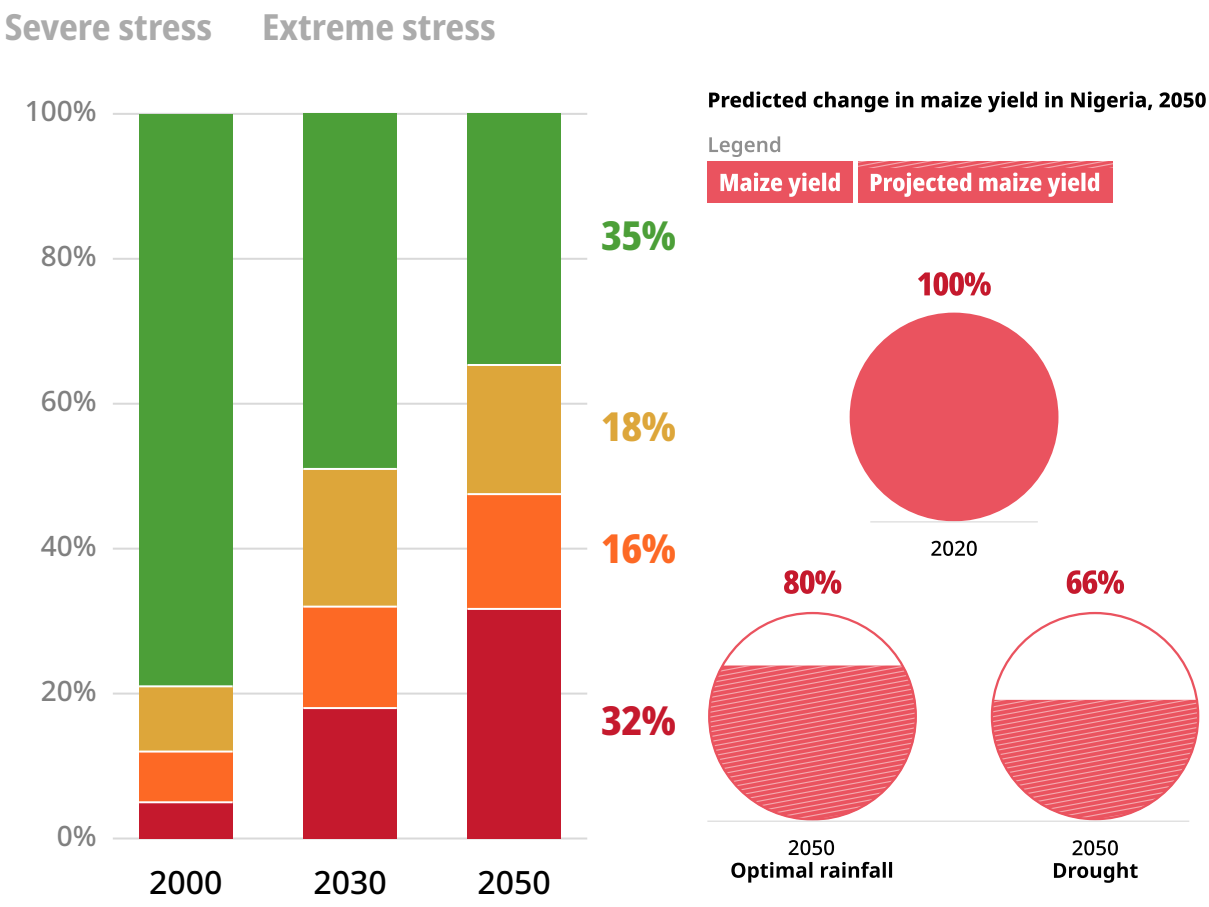
To more clearly see the potential impact of climate change on farming in Africa, our foundation recently supported development of a data visualization tool called an "Agriculture Adaptation Atlas." When experts saw the visual results, they were alarmed. The easiest way to understand is by focusing on a single crop: corn (or as most of the world refers to it, "maize").

Maize accounts for about 30% of all the calories people in sub-Saharan Africa eat. It's an incredibly important crop, but also a sensitive one. When temperatures exceed 30 degrees Celsius (86 degrees Fahrenheit), the growing process starts breaking down; pollination and photosynthesis slow. Every additional degree above 30 Celsius per day cuts crop yield by at least 1%. For example, if there are five days of 35 degrees Celsius (95 Fahrenheit) temperatures, that's five multiplied by five—25% of the harvest is lost.

Sub-Saharan Africa's most important crops are at risk

Heat stress maize distribution (%)

Show a Region or Country



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That's what the Agriculture Adaptation Atlas predicts: By the end of the decade, 30% of Africa's maize crop will exist in these conditions—as will every other food

aren't many obvious solutions. A recent survey by the World Bank and the Nigerian government asked farmers, *"How are you responding to lower crop yields,"* and the second and third most common responses were "eating less" and "selling livestock," while the top answer was just "do nothing."

Fortunately, there are other, better options.

How can farmers fight climate change? Magic seeds

Fourteen years ago, our foundation began supporting a group of African crop researchers. Their goal was to develop a new type of maize—what I started calling "magic seeds."

A farmer compares her recycled maize with her larger hybrid climate-resistant maize in Machakos, Kenya.

© Gates Archive/Alissa Everett

Of course, the seeds weren't actually magic, but by breeding select varieties of the crop, the researchers believed they could produce a hybrid maize that would be more resistant to hotter, drier climates. They succeeded wildly.

When researchers in Kenya compared plots of this new maize, which they called *"DroughtTEGO®,"* with the old one, they saw the *DroughtTEGO* farms were producing an

In fact, many farmers could finally afford to

send their kids to school or build new homes once they switched to *DroughtTEGO.*

This kind of agricultural innovation is happening around the world, including in Punjab. The region's farmers grow India's two main staple crops—rice in the wet season and wheat in the dry northern Indian winter—but climate change is upending their livelihood. In 2010, and then again in 2015, early heat waves turned the wet season into a dry one, overcooking the rice. In response, local farmers worked with the Punjab Agricultural University to find a new solution: a short-duration rice variety that required three fewer weeks in the field. It could be harvested before the climate change-induced heat waves cooked the crop. And it allowed farmers to plant their wheat earlier, too. With one seed, Punjab was supercharging two crops.

Innovations like *DroughtTEGO* maize and short-duration rice give me a lot of hope that agricultural productivity can still increase despite the changing climate. But I wish these new seeds would be adopted more quickly. Investment in agricultural R&D is still much too small.

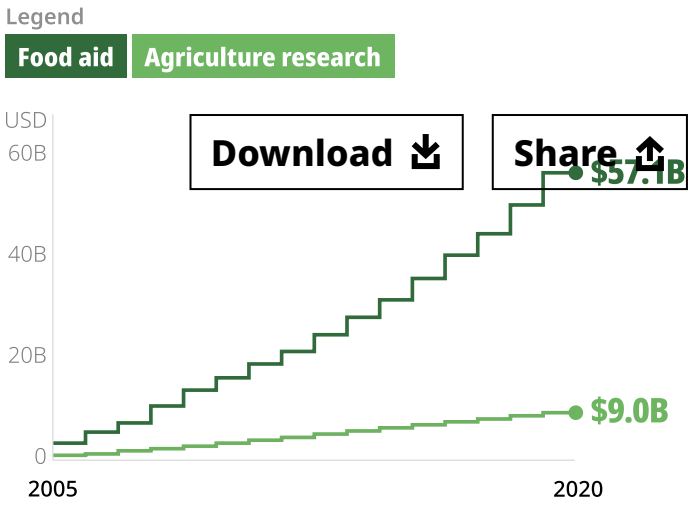
Let's go back to that skyrocketing graph of food assistance and place it next to the R&D budget for new innovations like magic seeds. That line is flat by comparison.

A missed opportunity to solve hunger over the long term

agriculture, too.

After all, productivity is not simply a “Jack and the Beanstalk” problem, where farmers can plant magic seeds and—poof!—their crops grow sky high. It’s more complicated than that. Farmers need support in many different ways, such as micro-financing so they can afford to buy fertilizer, or rural infrastructure like new roads so their crops can be easily transported to market. Even “the magic seeds” need adjacent investments so they can keep working like magic.

Cumulative spending on food aid and agriculture research



And they need to go through the proper checks, too. For countries that want to take advantage of these and other innovations, it helps to have strong systems and policies in place to help evaluate performance and safety, while efficiently delivering products to small-scale farmers. It’s critical if we want to get the latest seed technology to farmers as fast as we can.

AI for Ag

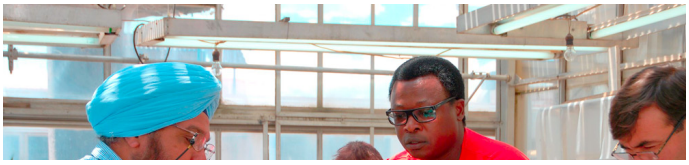
Short-duration rice and *DroughtTEGO* maize are producing big yields today, but they aren’t guaranteed to continue doing that in 2030 or 2050. Farmers will need to plant even newer seeds as the environment changes in unpredictable ways. How do farmers and researchers determine what

farmers could tweak and perfect over the centuries because the conditions were roughly the same. Everybody's farm looked more or less like their grandparents', so they planted the same things at the same time, maybe making a few innovations on the margins.

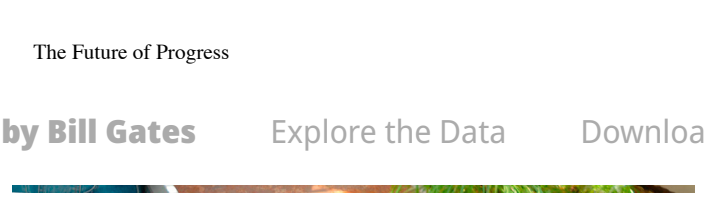
At the same time, breeding the best crops has largely been a slow, manual process conducted by a handful of modern plant breeders. CGIAR (formerly known as the Consultative Group for International Agricultural Research) is the world's largest network of crop breeders, and in Africa, they have just three people devoted to selecting the best bean varieties out of millions of potential options.

We need to speed this plant breeding work up, and one solution is what researchers call "predictive modeling." It's artificial intelligence software that processes the genome sequences of crops along with environmental data—everything from soil samples to satellite imagery—and then conjures up a data-based vision of what farms will need to look like in the future. From this computer model, researchers can identify the optimal plant variety for a particular place. Or they can do the reverse: pinpoint the optimal place to grow a specific crop.

This technology is still in its early stages, but similar predictive models—ones that anticipate where farms might be hit by an invasive species or crop disease—have



they could take preventative measures. By the end of 2021, Ethiopia hadn't seen its wheat crop decline at all. In fact, the country had its largest harvest ever.



Wheat trainees study seedling rust symptoms in El Batan, Mexico.
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Innovation, not just donations

Hunger might not be a completely solvable problem. No one can reasonably promise that every one of the world's eight billion humans will always have enough to eat. *But ensuring that sub-Saharan Africa and other low-income regions can feed their own people?* That's a very achievable challenge, so long as the world changes how it approaches food crises.

It's good that people want to prevent their fellow human beings from starving when conflicts like Ukraine interrupt the food supply, but we also have to recognize that those crises are symptoms of a deeper problem—many countries don't grow enough yet, and climate change is making farming even harder. That challenge can't be solved with donations. It requires innovation.