

Viewpoint: World must embrace CRISPR, synthetic biology to boost food production in the face of climate change



With the global population expected to top 9 billion by 2050, and climate change impacts likely to reduce crop yields 25-30% in that time, the question increasingly becomes **how to keep everyone fed**. That query assumes particular urgency in light of a new global report that calls for revolutionary changes in agriculture and other key areas to ensure that people aren't pushed further into hunger and poverty, leading to increased conflict and political instability.

The time is now

The **report by the Global Commission on Adaptation** noted that climate change is already worsening food insecurity, and urged governments to promote “climate-smart” interventions to boost agricultural productivity.

Technological innovations, such as [gene editing](#) and [synthetic biology](#), offer tools for developing crops that can withstand climate change impacts, such as [drought](#), heat, intense rainfall and [plant diseases](#) — if they are allowed to move forward.

“Food production today continues to face old and new threats in ways that are more complex than ever imagined,” said Nassib Mugwanya, an agricultural communications expert from Uganda who is now pursuing a doctorate at North Carolina State University. “The situation gets even worse in developing countries, where much of the food production is reliant on an increasingly changing climate and less productive farming practices. The urgency needed to address these threats requires opening doors to all options that can be of help.”

Bill Gates, the co-chair of both the Global Commission on Adaptation and the Bill & Melinda Gates Foundation, expressed similar views in a statement that accompanied the release of the report.

People everywhere are experiencing the devastating impacts of climate change. Those most impacted are the millions of smallholder farmers and their families in developing countries, who are struggling with poverty and hunger due to low crop yields caused by extreme changes in temperature and rainfall. With greater support for innovation, we can unlock new opportunities and spur change across the global ecosystem.”

– Bill Gates, co-chair of Global Commission on Adaptation

Though Gates and the Global Commission outlined specific steps for achieving these revolutionary changes, such as investing in crop research, the call for using new breeding technologies (NBTs) to help agriculture adapt to climate change is not new.

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The United Nations Food and Agriculture Organization issued a similar endorsement in its [2016 report](#): “Biotechnologies, both low- and high-tech, can help small-scale producers, in particular, to be more resilient and to adapt better to climate change.”

More recently, Petra Jorasch of the International Seed Federation published [a study](#) that underscored the need for plant breeding innovations to effectively address challenges associated with climate change and a growing population.

Improved plant varieties developed through NBTs have a better capacity to withstand pests and diseases while using fewer resources, her report noted. They also offer stable yields in an unstable climate.

“The new tools of breeding, such as oligonucleotide mutagenesis or [CRISPR-Cas9](#) are more helpful than the previous techniques because these tools allow breeders to do their job in an even more precise and efficient manner,” Jorasch wrote.

New breeding technologies have a great potential in tackling major threats to food security in more promising ways than old technologies. Closing doors to these new breeding technologies is like stopping a major required ‘software upgrade’ in food production, which may lead to a ‘freeze’ or serious crash in the system.

– Nassib Mugwanya, Ugandan agricultural communications expert

A global front for NBT innovations

Innovations in plant breeding can also help agriculture shrink its sizable environmental footprint by making more efficient use of limited resources, such as freshwater, and reducing the need for [nitrogen fertilizers](#), the manufacture of which results in substantial carbon emissions. Equally important, these crops have the

potential to deliver good harvests by improving the [efficiency of photosynthesis](#), as an example. Achieving better yields on existing acreage can reduce the pressure to bring wildlands, such as the Amazon rainforest, into production.

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The United States, Japan, Australia, Argentina, Brazil, and other countries have streamlined the regulatory process for these new breeding techniques, and China is [investing heavily](#) in gene-edited crops in a bid to feed its 1.4 billion citizens.

However, the European Union and some developing nations in Africa and Asia are lagging behind, in part because they either have a regulatory system that is cumbersome or none at all. In an effort to support gene editing, the African Union recently began exploring ways to harmonize the [biosafety regulatory framework](#) among its 55 member nations.



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If Africa does not adopt new breeding technologies, I think it will lose a great opportunity to improve its agricultural production system to ensure food security and the general wellbeing of its people,” Njuguna said. “Economically, this will be a poor decision since an enhanced

agricultural production system, coupled with vast land and favorable climatic conditions throughout the year, would not only ensure a thriving local food market and employment for Africa's people but would also give individual countries a competitive edge in the world food export market, making the continent the world's breadbasket.

Gene editing also can make a significant contribution to food security, in part by improving the so-called "[orphan crops](#)," like cowpea, pulses, and cassava, that are nutritious staple foods in developing nations, seven international researchers wrote in a recent [article in Science](#). These crops also represent an important source of income for smallholder farmers, thus helping to alleviate poverty, the article noted.

Supporting innovations for generations to come

[Albert Caraan, a pioneer member of UP Grains](#), an organization that offers informational workshops on biotechnology concepts to high school students in far-flung agricultural communities in the Philippines, sees other potential benefits.

Adoption of NBTs could, in some way, entice the youth to be involved in agricultural research," he observed. "Gen Z has more affinity for new technologies, thus giving them the chance to get hands-on experience in this field and possibly bringing more young people to agriculture.

This is important, since many of the world's farmers are over the age of 60, and young people, including Gen Zers, have been reluctant to pursue the economic uncertainty and hard physical labor that often accompanies farming.

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Njuguna also believes that people will welcome NBTs — provided they are accompanied by adequate public education. This includes information about how the science works, safety procedures that are in place and the various benefits that these breeding technologies hope to confer.

"I think that there will be great expectations among the people since this touches on their food and livelihood," Njuguna said.

In my opinion, people will expect that the new technology will be a game-changer and solve a good number of challenges that they are currently facing. For instance, farmers will expect most pests and diseases that affect their crops and livestock will be eradicated for good and they can also grow plants that survive drought and salinity. Pastoralists will expect that they don't have to walk miles to find fodder for their livestock. I also think that most end-product consumers will expect that the technology will result in higher amounts of foodstuffs available throughout the year at affordable prices. For the growing middle class that is more aware and cautious with their food, they will expect that the new breeding technology will result in food produced safely for consumption, with higher nutrient content and more variety at fair prices.

– Elizabeth Wangeci Njuguna, plant molecular biologist, International Centre for Genetic Engineering and Biotechnology, Cape Town

Ultimately, Caraan said, NBTs likely hold the key to preventing the “push into poverty” that the Global Commission on Adaptation hopes to avoid.

I believe that the adoption of new breeding technologies in agriculture will boost global efforts to eliminate poverty and hunger,” Caraan said. “Embracing NBTs will provide a powerful tool in our arsenal to combat the negative effects of climate change by expediting the breeding processes. However, strict and stringent regulations will hamper our chances in achieving global goals, most importantly, no poverty and zero hunger.

Joan Conrow has 35 years of experience as a journalist, editor, and communications consultant. She specializes in environmental issues, biotechnology, and agriculture. Follow her on Twitter [@joanconrow](https://twitter.com/joanconrow)

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