Rescuing Africa’s staple orphan crops—sorghum, millet, cowpea, cassava and sweet potato—with biotechnology could help feed millions of people

The year is 2100 and Africa is home to the world’s largest population of young people, with its current leader – Nigeria – having close to a billion people in a territory smaller than the State of Alaska. Although it’s projected that some of the countries behind this phenomenal growth will be among the fastest-growing economies globally, this does not take into account the potential food shortages that could result from the deleterious effects of climate change, water shortages, arid environments and famines exacerbated by conflicts in different parts of the continent.

Currently, the world decries that more than 821 million people – more than ten percent of the global population – do not eat enough nutritious food to live a healthy and productive life, which further translates to one in nine people going to bed hungry every day and about three million dying annually from malnutrition. Sadly, this figure is expected to rise in the coming decades and much of it will probably come from the global south.

Although the continent possesses 60% of the world’s unused arable land, African countries are among the worst hit by global food shortages (in terms of nutritional content of food and crop yields), and much of their food must be imported. For instance, Nigeria spends slightly above $3 million dollars daily importing rice, a crop almost every Nigerian eats. Can you imagine how much will be spent on food imports in the next century if farm production is not increased?

The green revolution of the 1960s contributed to phenomenal growth in agriculture—reducing hunger, malnutrition and increasing exports—across India, Pakistan, Malaysia, China and Indonesia, with the expertise of agricultural scientists and funding from capitalists granting some of the world’s poorest countries a reprieve from poverty.

Africa missed the green revolution, sadly. But there is a way to defuse the continent’s impeding food shortage time bomb. By funding research into so-called orphan crops, commercially neglected but vitally important staple foods in Africa, governments, international organizations and advocacy groups can help the continent’s exploding population launch its own green revolution, with the help of modern crop breeding technologies such as CRISPR-Cas9 gene editing.

Lopsided research into crop breeding

Research into crop improvement and productivity has doubled in recent decades, mainly due to a vibrant seed industry and rising population, which cascade into increased demand for greater quantities of more nutritious food. But this increase has occurred unevenly. Sub-Saharan Africa is home to the vast majority of the world’s poorest nations and ranks among the lowest in budgetary allocation to agricultural research and development. As a result, there’s a lopsided quality to this expansion of agricultural production as the vast majority of crops being researched and cultivated are those consumed by rich countries.
This is understandable, since it would be extremely odd for a country to invest in what it does not consume. For example, the majority of researched and produced crops in Japan consist of rice, wheat, and soybeans. In the United States, they include wheat, soybean, corn, and barley. These crops are not among the frequently consumed foods in most parts of the developing world, especially Sub-Saharan Africa where staple crops include sorghum, millet, cowpea, teff, yam, cassava, and sweet potato. Due to the infinitesimal amount of financial resources invested in researching these crops, their yield and nutritional content don’t compare to corn, wheat, soybean, and rice.

**Importance of orphan crops**

Collectively, these crops are known as orphan crops – plants that are characterized by poor growth and development when compared to their consumption and potential. Generally, orphan crops are not widely cultivated across the globe or traded significantly in international markets, but are cherished as part of the local cultures where they are cultivated. Being native to many parts of Africa, they are well adapted to their environments and thus can be utilized as part of a sustainable but intensive agriculture program that capitalizes on the latest tools of biotechnology.

**Rescuing orphan crops with modern plant breeding**

Targeting orphan crops with modern plant breeding techniques, gene editing for example, makes sense for two major reasons. First, these biotech tools allow researchers to relatively quickly and cheaply edit the genomes of these plants to help them to fight off disease and produce higher yields. Low costs and faster development times are crucial for financially strained nations with rapidly growing populations. Secondly, and perhaps more importantly, orphan crops have unique characteristics that will benefit the people in most dire need of help.

Cereals such as sorghum, teff, millet, fonio millet (acha rice), quinoa, and buckwheat are grown in some of the poorest but fastest-growing countries. Teff (*Eragrostis tef*) is highly cultivated and consumed in Ethiopia, Africa’s second-most populated country, which is projected to skyrocket to almost 200 million people by 2050. The crop offers numerous benefits to humans, livestock and the planet. Due to its natural drought resistant characteristics, it can withstand dry environments and is suitable for use as fodder for horses and cattle. The crop is rich in dietary fiber, low in sugar and full of protein, and consumes fewer resources while growing—but does so faster than comparable crops. And it’s gluten free to boot.
Important legumes or pulses include Bambara groundnut, cowpea, chickenpea, lentil, vetches, grass pea, and horse gram. These crops, which are great sources of protein, are cultivated mainly in regions prone to unstable climates and, as a result, have developed a strong resistance to the effects of harsh weather. Recognizing its importance as a staple food, Nigeria recently approved a GMO cowpea resistant to the voracious maruca worm pest. The enhanced crop was welcomed by the country's farmers, many of whom previously refused to plant it, illustrating how improving orphan crops can make a tremendous difference in Africa.

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Bambara groundnut, another important staple, is highly drought resistant and well adapted to varying climates, from arid Botswana to tropical and wet Indonesia. The crop plays an important economic role as the third most cultivated plant in the West African country of Mali. Additionally, the crop's leaves are rich in nitrogen and potassium, thereby serving as an additional source of animal feed while it provides protein for Africans who cannot afford to consume animals. Significantly, Africa's most populated country, Nigeria, is the largest producer of Bambara.

As is often the case with food and agricultural issues, the challenges holding back investment in nutritious orphan crops are not technical, but political and social. Gene editing can be used to enhance these culturally important plants, and dozens are now the focus of breeding programs utilizing a variety of breeding techniques. However, uncertainty around how new breeding techniques such as CRISPR will be regulated is an open question, even in developed countries like the US and EU member states. Moreover, activist opposition to advances in biotechnology continue to present roadblocks all over the world. If these obstacles can be surmounted, Africa can move much closer to feeding itself in the coming decades.
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