Feeding the World without GMOs

The current world population is estimated to be just over seven billion people. By 2050 an estimated nine billion people will be living on Earth. Feeding two billion more people is a matter of eminent concern.

How will this monumental task be achieved?

It won't easy but I'm confident it will be done.

Let me preface my remarks by saying that based on the compelling research displaying their safety and efficacy I believe Genetically Modified Organisms (GMOs) *should* be a part of the solution in feeding the world. Nevertheless, I understand that thoughtful people disagree on this issue. I also acknowledge that opponents of GMOs are winning the public relations battle with many governments and consumers around the world. Major food producers, and even fast food chains, are now actively promoting their non-GMO status. Regardless of how the GMO debate plays out I am confident that innovative farmers and agri-businesses will rise to the challenge of feeding the world's population.

Here are a "baker's dozen" ways I believe the world will be fed in the near future *without* GMOs:

#1: A Data Revolution: Continued advances in computing processing power, data storage, "Big Data," robotics, sensors (and the "Internet of Things") and satellite technology will continue to drive advances in prescriptive planting, precision agriculture, the global food supply chain management and water usage monitoring. One commentator has likened the improvements in crop yield from better data management as being "comparable to the first green revolution." In addition to producing more food on the same amount of land in the U.S., China and Europe, these advances—especially as they become more affordable—will also increase yields in lands as diverse as Zambia, Brazil, and Ukraine.

#2: Better Packaging: An estimated 30 to 40 percent of all food never reaches the end consumer. This number will plummet in the coming years due to advances in material science and nanotechnology, which will keep food fresher for a longer period of time, thereby dramatically reducing waste and provide more fresh food to remote locations.

#3: The Agribiome, Microbials and Biopesticides: Farmers and scientists have known for some time that soil bacteria can have a positive impact on crops. Thanks to low-cost DNA sequencing technologies scientists are now locating and identifying these beneficial bacteria at an astounding rate. The impact is that the bacteria and fungi with the most positive traits can be applied to crops to increase yields. The bacteria and fungi will help the crops to fight infestation from diseases and insects, as well as allow them to grow in a broader range of conditions, including land exposed to drought, extreme heat or cold and even high salinity. In one stunning example, researchers have used bacteria to increase the

yield of cassava, a root crop that is a staple in many parts of the developing world, by 20 percent, while simultaneously slashing the amount of phosphorus in half.

#4: Marker-Assisted Breeding: For over 9,000 years mankind has been laboriously identifying crops with positive attributes and cross breeding them. Low-cost DNA sequencing is now speeding up this process by allowing researchers to "mark" crops and plants with the most beneficial genes. These plants and crops are then conventionally bred. The process could render the need for farmers and agri-businesses to genetically modify crops unnecessary. A more detailed explanation of the technology and the process can be found in this insightful article from Scientific American.

#5: Smarter Crop Rotations: Big problems don't always require big fixes. Researchers at Iowa State University conducted a large study which demonstrated that by simply adding alfalfa and oats to the rotation schedule of corn and soybeans, nitrogen fertilizer and herbicides decreased by 88 percent and the amount of toxins found in the groundwater decreased a staggering 200-fold, while no adverse impact on profits.

#6: Perennial Crops: Only twelve percent of the world's crops are grown on high quality soil. A larger percentage, almost one-third, is grown on marginal quality land. This lower quality renders the soil vulnerable to erosion. The benefit of perennial crops – those that grow for multiple years without needing to be replanted -- is that they have deep roots that prevent erosion and lessen the need for fertilizer. Deep roots also allow the crops to tap into deep-water reserves thereby reducing the demand for water.

#7: Better and More Affordable Desalination Technology: One of the great ironies of life on earth is that while water covers 75 percent of the planet's surface, only a fraction of that water is fresh and thus capable of growing crops. The ability to take the salt out of ocean water has existed for a long time. The problem is that desalination is a costly and energy-intensive process. New advances in material science, particular graphene, might soon pave the way for affordable desalination. If this occurs it will not only benefit drought-stricken areas such as California and China, it could also open vast new areas of land in Australia and Africa (among others) for farming.

#8: Renewable energy: Even if desalination technology does not improve appreciably in the future, the cost of the energy to operate desalination plants will drop thanks to continued advances in solar, fuel cell, wind and wave power, and advanced battery storage technologies. The combination of affordable renewable energy and low-cost desalination could open up vast tracts of land in new areas around the world where farming is currently hindered by a reliable energy and water infrastructure.

#9: Urban Agriculture and Vertical Farming: From Singapore, Minneapolis, Copenhagen and all the way to Jackson Hole, urban farms are springing up. Fueled in part by the previously mentioned advances in renewable energy and more efficient LED lighting, innovative urban farmers and entrepreneurs are now growing a variety of crops, including lettuce, tomatoes and mushrooms in locations closer to the end users. With an estimated 60

percent of the world's population expected to live in cities by the year 2050, it only makes sense for more food to be grown closer to where these people live.

#10: Lab Grown Proteins and Meats: It has been estimated that a single pound of steak requires an estimated five pounds of corn and 1800 gallons of water. In response, a company called *Impossible Foods* has already created soy "chicken" strips and "beef" with pea proteins; while another firm, *Hampton Farms*, is working to perfect a protein material that tastes and functions exactly like eggs—but without any chickens. And, as if that isn't enough, a third company *Modern Meadows*, is making fake "meat" using stem cells. The long-term benefit is that these companies might well manufacture protein more efficiently than the livestock and poultry industries.

#11: Bugs: Over time people's taste and preference in foods change. In the U.S. our ancestors from Plymouth Rock would scarcely recognize the feast we now consume on Thanksgiving. In this same way, it is possible that in the future much of the world's growing demand for protein might come from sources as other than meat and chicken—as noted above. Another strange but plausible source of protein in the future is bugs (as this article explains). Before recoiling too much at the thought, it is worth noting that much of the world already consumes bugs and some of the finest chefs in America are now experimenting with them as haute cuisine.

#12: Gene Editing: In the past years, researchers and scientists have developed extraordinary new tools that allow for genes to be edited. In China, researchers have already created wheat that is resistant to a common disease. This suggests that not only will more wheat make it to market, but also that less fungicide will be necessary to fight off the disease. (If gene-editing sounds suspiciously like gene modification the difference is that the former only removes an existing gene, whereas the latter inserts a foreign gene—which is what many opponents of GMOs don't like.)

#13: Genetically Modified Crops and Bacteria for Fuel: This last reason might seem like a bait-and-switch based on the title of this post—but GMOs could still be part of the solution in a manner on which both proponents and opponents of GMOs may agree. For instance, what if the crops that are genetically modified aren't used for food for either animals or humans but instead for fuel? If GMO corn could increase the yield 40 percent per acre, (as has been demonstrated,) and if that corn could be grown in such a way that it won't contaminate other corn, might opponents be willing to accept such use of GMO crops? It is possible, especially, if the environmental benefits of GMOs (e.g. growing more crops with less water, fewer pesticides, insecticides and fungicides) are compelling enough. Another approach to consider is modifying the genes of bacteria so that they could, for example, process sugar more efficiently and thus produce biofuel more affordably. To understand the potential of this approach consider that researchers at UCLA have already increased the amount of biofuel that can be produced from sugar by 50 percent. In addition to such biofuels reducing greenhouse gas emissions, the advances—by producing more biofuel with fewer crops—would also ensure the remaining crops would be used to feed people.
Alone each advance is only a part of the solution. Together, however, they constitute a

formidable path to meeting the dietary needs of a growing world population.

Jack Uldrich *is a global futurist, best-selling author and keynote speaker. He has addressed agriculture audiences on five continents.*

Interested in some related articles on the future of agriculture by Jack? Checkout these posts:

Urban Agriculture's Tasty and Tantalizing Future
Five Technological Trends in Agriculture
The Future of Farming: Growing Up Everywhere