TIMES FACE-OFF

With Climate Change Impacting Agriculture And Deepening Food Insecurities, Is It Time For India To Bite The Bullet On GM Crops?

Genetically engineered crops are a science-based solution to hunger

Agriculture globally must meet the challenge of feeding a growing population while minimising its environmental impacts. There is an additional challenge in South Asia and Africa of making farming profitable for small landholders. I recently wrote a Perspective article, published in Dialogue—an online journal of the Indian Academy of Sciences, Bangalore, assessing the possibility of achieving low-input, high-output agriculture for India. Let me highlight some of the key considerations.

A United Nations report issued in 2019 predicted that the global population would peak at 11 billion in 2100. A new forecast published in Lancet in 2020 pegs global population at around 9.7 billion in 2064. Even with the more comforting Lancet prediction, there will be an additional 2 billion people on the planet. The population of India under the best scenario will peak at 1.6 billion in 2048, a number very close to the global population of 1.65 billion in 1900.

While the technologies that save human life are widely appreciated, how the world has fed this massive increase in population since 1900 is scarcely talked about. Four post-1900 developments have contributed to feeding the world—nitrogenous fertilizers, mechanisation, crop protection chemicals, and systematic plant breeding. Dwarf wheat and rice, hybrid maize, and incorporation of disease resistance into these mega crops averted famines not only in Asia in the 1960s but in advanced countries also.

The current challenge in agriculture is to increase productivity while lowering environmental footprint and assuring long-term sustainability of agricultural operations. The most serious implications for sustainability emanate from the over-exploitation of groundwater resources in growing crops like wheat, rice, and sugarcane under irrigation in many parts of the country. The total estimated groundwater depletion in India is in the range of 122-199 billion cubic meters.

Bringing about low-input, high-output agriculture will require the cultivation of water-frugal crops, soil-analysis-based use of fertilizers, and conservation agriculture (returning the crop residues to the soil rather than burning these). Crop diversification holds the key to sustainability and food and nutrition security. A moot question is —why are farmers not switching from the long-term ruinous rice-wheat cropping cycle in the intensively irrigated north-western parts of India? A quick reaction would be the availability of a minimum support price (MSP). However, an output analysis of the oilseed, grain legume and coarse grain crops would show that these suffer from low yields not only under rain-fed but also under irrigated conditions. The average yield of these crops has only marginally improved to more than 1 tonne/ hectare, much below the global averages, due to two reasons—a narrow genetic base, and most important their susceptibility to pests and pathogens.

Fortunately, to meet the challenges of pests and pathogens we have new plant breeding technologies such as marker-assisted breeding, genetic engineering (GE), gene-editing, and genomics. There are no controversies on the use of molecular markers for bringing precision into conventional breeding. The field of genomics has exploded in the 21st century. Genome assemblies of all the major crops are available. This knowledge has been further extended by sequencing the germplasm and even the wild relatives of the crop species. GE technologies allow genetic information to be incorporated from very divergent organisms into a plant, and gene-editing allows creating mutations in a target gene, something we have been trying through x- or gamma irradiations or chemical mutagenesis in a highly inefficient manner. GE and gene-editing technologies, backed by extensive genomic information, have already shown their value in protecting crops from pests and pathogens and improving their nutritional value. More and more countries are accepting GE crops. Many advanced countries, barring the EU block, have removed any biosafety analysis for the gene-edited crops.

There are all kinds of reasons for people opposing GE and now gene-editing technologies. Some don't like the idea of transnationals, which own patents on these technologies, to have an overarching influence on national food security. Some want to resurrect pre-1900 agriculture not realising the world has moved on. Many in the developed countries do not trust that developing world institutions can cope with the new technologies. Some very vocal opposers enjoy the cult status they have acquired amongst the technology deniers.

I hope we have learnt some lessons from the Covid experience. At the end of the day, it is science-based solutions that matter. Science academies all over the world, after some very involved analysis, have not found any ill-effects of the GE crops that have been grown since 1996 and are currently sown in around 190 million hectares of land around the world. Instead of negativity, let us aspire to be global leaders in the new plant-breeding technologies to bring about low-input, high-output agriculture that is sustainable not only for India but all the developing world. Big challenges can be only met with a dynamic outlook.

Pental was Professor of Genetics and Vice-Chancellor, University of Delhi

GM technology represents a hyped but failed model of agriculture

It will be deeply problematic to assume that the time is right for genetically modified (GM) crops in India. The many concerns with regard to GM crops have not gone away, and, in fact, the evidence with regard to adverse environmental impacts is stronger now than ever before. Whether it is pest resistance, secondary pest onslaught, superweeds, impact on non-target organisms or increased chemical usage, the evidence emerging from countries that opted for largescale GM crop cultivation cannot be wished away.

Predictions around seed freedoms of farmers being curtailed are not exaggerated either. Corporate control over farming is eased by GM technology (with accompanying IPRs), and the massive consolidation in the seed industry is reflective of this reality.

Various claims around stress tolerance, nutrition and yields have turned out to be hollow, including in India with its Bt cotton experience. Cotton yields have been around 460 kgs per hectare in the recent past, despite most cotton being GM. The most impressive yield growth is still between 2000 and 2006 (from 278 kg to 521 kg/ ha) when GM cotton adoption was marginal. There are no such yield increases thereafter, despite 'new generation' and illegal GM cotton with multiple genes taking over our cotton cultivation. On the other hand, increased illegal use of glyphosate is bringing its own problems. Though GM was supposed to be more resistant to pests, chemical usage (including pesticides) in India's cotton cultivation has actually increased. This season, cotton farmers in North India have been protesting over pink bollworm infestation. Before that there was a white fly attack. It is noteworthy that 24 countries ahead of India in terms of cotton yields do not grow GM cotton.

The government's moratorium decision note on Bt brinjal reflects everything that is deeply problematic with this GM food crop, as well as all the regulatory lacunae. In GM mustard (which is a herbicide tolerant crop but not been tested as one), the yield-related hype was found to be untrue by many agricultural scientists.

An overwhelming majority of countries have never ventured into GM crop cultivation. More countries have active bans now. Several countries like Germany, Sweden, Egypt, Cuba, Romania, Burkina Faso and others have stopped GM crop cultivation after initial forays. China has reduced its GM cotton area significantly. There are concerns that herbicide-resistant GM crops (the largest planted GM crops) can lead to superweeds and increased use of chemicals. To this day, the largest areas planted to GM crops are in only 4-5 countries even 25 years after the first commercialisation of GM technology in agriculture.

In the recent past, genome editing has been touted as a new innovation. While Europe has already begun regulating genome editing, in India, the government is creating guidelines that keep much genome-editing out of regulatory purview.

Recently, India decided to allow import of 12 lakh tonnes of crushed and de-oiled GM soymeal cake, violating statutory regulatory provisions. The Environment Protection Act 1986's Rules for gene technologies framed in 1989 mandate the Genetic Engineering Appraisal Committee (GEAC) to regulate not just Living Modified Organisms but also products and substances thereof. While a 2007 notification by the Ministry of Environment (which was kept in abeyance multiple times until 2018) made GEAC wriggle out of regulation of GM foods, GM feed regulation has now become nobody's business to regulate! Both MoEFCC and FSSAI claimed that it is not their mandate to look at livestock feed from GM crops, even though both have regulatory responsibility for the same. They ignored that GM soymeal cake will have GM protein as well as herbicide residues that will be ingested by poultry and livestock, which could potentially enter the human food chain. There is ample published scientific evidence of adverse effects of GM food/feed on animals. Meanwhile, domestic soybean producers are also going to be affected with harvest season being close, with cheap imported GM soymeal. It is now hoped that the Delhi High Court and Supreme Court will look into this decision of the government, which breaks its own regulatory requirements.

Meanwhile, let us look at the critical juncture that we are standing at when it comes to food, farming and farmers. We need solutions in agriculture that provide dignified incomes, livelihoods and employment to a large population, tackle malnutrition at both ends of overand under-nutrition, uphold trade security,

regenerate natural resources and address climate change. Unsafe and reductionist GM tech has no solutions to provide here. GM technology represents a hyped but failed model of agriculture, and its time should never come, given the mistake already made in cotton in India. However, farmer-led agro-ecology, as a holistic approach that addresses all the above challenges, holds hope. In the recent past, many farmers of Haryana associated with Kudrati Kheti Abhiyan showcased how the alternative does indeed hold promise on multiple fronts.

Kuruganti is with the Alliance for Sustainable & Holistic Agriculture (ASHA-Kisan Swaraj)

CONTROVERSIAL HARVEST: In 2002, Bt cotton became the first genetically modified crop to be introduced in India

GMO VS GENE EDITING: THE DIFFERENCE

- GMOs, genetically modified organism (or genetically engineered, as they are commonly called in the science world), are the result of tweaking the DNA of a living organism
- Genome-edited crops (GECs) are generated through very small and specific changes made to a plant gene that can have a significant impact on that plant's resilience to its environment and ability to grow with fewer inputs

CONTROVERSIAL HARVEST: In 2002, Bt cotton became the first genetically modified crop to be introduced in India

GE and gene-editing technologies have already shown their value in protecting crops from pests and pathogens and improving their nutritional value Bt cotton hasn't led to increased yields despite 'new generation' and illegal GM cotton with multiple genes taking over our cotton cultivation

Deepak Pental

FOR

Kavitha Kuruganti

AGAINST

Participate in the reader poll and give comments on this debate by visiting **http://bit.ly/timesfaceoff** or scanning QR code. Poll results and top comments will be featured in the paper