FACT SHEET

GMOs & SEEDS
WHAT YOU NEED TO KNOW

Seeds are a symbol of all life on earth and as such have social, cultural and political importance in every corner of the world. Since the dawn of agriculture farmers have been selecting, saving and exchanging seed and, in so doing, have developed a wide variety of crops which are adapted to their local human and non-human environment.

This rich seed culture is now being eroded by the input-heavy industrial farming model, where uniformity has replaced diversity and where seeds have become about money and control. Nowhere is this more pronounced than in the rise of genetically modified organisms (GMOs).

A GMO is a plant, animal or microbe which has had its DNA altered by genetic engineering techniques. GM plants have been commercially available in North America since the mid-1990s.

Today the biggest users of the technology are the USA Brazil, Argentina, India and Canada. It is estimated that around 10% of the world's arable land is planted with GMO crops, but in some areas the impact has been far greater than this. In the US in 2018, GMOs made up 94% of all soybeans, 94% of all cotton and 92% of maize planted.

Since their introduction, one of the most contentious aspects of GMOs has been a new intellectual property paradigm which has accompanied them. This includes patents, contracts farmers have to sign upon the purchase of the seed, and the corporate surveillance of farmers to ensure the enforcement of the contracts. As a result, farmers cannot own GM seed and are legally prohibited from saving and replanting it.

This new paradigm places burdens and restrictions on farmers which affect their autonomy and can have a negative impact on their businesses.
In short, genetic modification has helped turn seeds into a global commodity in service of large corporations. This has changed the fundamental nature of the way we relate to seeds and has helped establish an industrial model of farming that is no longer working for people or planet.

Corporate concentration

The biotech corporations that develop and own GM seed dominate the global seed market. In the 1980s the market share of the ten biggest seed companies was below 15%. Today, the ten largest companies now control 70% of the market.

These same corporations manufacture the fertilisers and pesticides used in industrial farming. Despite media-friendly promises of crops with enhanced nutritional value or drought tolerance, the reality is that the range of traits available commercially from GMO seeds remains relatively small and dominated by herbicide tolerance and insecticide-producing varieties.

These crops are designed to work together with the chemicals, therefore locking farmers into an industrial food system which relies heavily on artificial inputs and mechanisation, and focusses attention on high yielding monoculture commodity crops to the exclusion of all other criteria.

No seed saving

Seed saving is vital in the fight for food sovereignty across the world.

In Africa up to 80% of the food produced comes from homegrown farmers' seeds. Even large arable farms in the US, which GM supporters claim have no interest in saving seed and would be buying new seed every year anyway, have a long history of seed saving – as much as 60% some years.

Research from GRAIN shows that farmers' seed practices are highly diverse, sophisticated and based on the rich cultural heritage and traditional

knowledge of local communities which have been handed down over generations. GM seeds are having a huge impact on this.

Most or all of the private contracts which farmers are obliged to sign upon purchase of GM seed contain a "no saved seed" provision, which the biotech companies claim is essential to help them recoup the costs of developing the seed. The implications of this for farmers vary across the world. In the US, biotech companies monitor farmers for breaches of contract such as saving seed, and often sue farmers where they find such infringements.

In other countries biotech companies have found a way around legislation which protects farmers' rights to keep and plant seeds. In Brazil, the Plant Variety Protection Act allows for farmers to save seed, so Monsanto (now owned by Bayer) introduced a dual system of royalties. The company initially charged a 2% royalty on the sale of its soybeans and an additional royalty – 3% of farmers' sales – when soybeans are grown from saved its glyphosate-resistant 'Roundup Ready' seeds.

In 2019 a court ruled that farmers are not allowed to save Roundup Ready seeds, effectively overruling the Plant Variety Protection Act and putting Brazil in agreement with the US and Canada.

In India insect-resistant GM cotton seeds were introduced in 2002 and now account for 90% of all cotton planted there. The political landscape was very different in India compared to most of the countries that grow GM crops, with millions of farmers on small land holdings, intractable legal enforcement issues and the political impossibility of suing farmers.

To get around this, Monsanto sub-licenses to seed companies the right to introduce its genes into their varieties, for which they make a lump sum payment to Monsanto as well as a percentage of royalties on each packet of seeds they sell. It was also stipulated in the sub-licensing agreements that seed companies were only allowed to add the insect-resistance trait into proprietary hybrid varieties of cotton.

This was a key component of the company's strategy: since hybrid varieties become unreliable in the second generation it ensured that farmers would have an incentive to buy new seeds each season.

Locked into an expensive system

The prohibition on seed saving means farmers who plant GMO crops have to purchase new seed every year. Biotech companies control the price of these seeds, which cost farmers 3-6 times more than conventional seeds. This, combined with the huge chemical inputs they require, means GM crops have proved more costly to grow than conventional crops.

GM crops were released onto the market with a promise that they would increase yields, and therefore the farmer would get more money per acre of crop and better returns overall. This has proven to be false. In fact, according to a 2014 US government report yields from GM crops can be lower than their non-GM equivalents.

In India, an analysis of 20 years of data suggests yield increases were unrelated to GM cotton's introduction and is better explained by higher fertiliser use, better irrigation and the introduction of new pesticides.

Loss of ownership and control

GM seeds have led to a loss of ownership for farmers who choose to plant them, and a loss of control for farmers who choose to plant them and, increasingly, those who don't.

Biotech companies retain ownership of the seed and plant whose genes they have altered. Despite this, contracts between the companies and farmers often prevent farmers from filing lawsuits against the companies for poor performance of the seed, instead mandating them to enter into arbitration with the company, typically within as little as 15 days from when the problem is first observed.

Moreover, contracts sometimes contain clauses which limits the liability of the biotech company in the event that use of the GM seed had a negative impact on another aspect of the farmers' operation. The contracts, therefore, amount to the farmer losing control over multiple aspects of their work.

Due to the disproportionate emphasis on GM crops, conventional seed varieties are, in some cases, no longer widely available, leaving farmers with less choice and control over what they plant. A number of other side effects of the GM industry restricting farmers' control of what they plant have emerged. For example, recently in the US a number of glyphosate-resistant weeds have emerged, leading to the development of soybeans which are resistant to other types of herbicides, such as dicamba.

Dicamba is a much more toxic herbicide than glyphosate and there has been a sharp rise in the number of neighbouring farmers reporting damage

to their crops from drift. An investigation found that large numbers of these neighbouring farmers were forced to switch to planting dicamba-resistant GM varieties themselves due to these loses.

A risk of contamination

Farmers who have chosen not to grow GM crops can find their crops contaminated with GM crops as a result of seed impurities, wind or insect-borne cross-pollination, volunteer or feral plants, and/or inadequate harvest and handling practices. This problem is particularly acute for wind-pollinated crops, such as oilseed rape, where pollen can travel up to 3km.

To reduce the risk of contamination, organic farmers are advised to stagger plantings, establish buffer zones and closely monitor their crops and harvesting and processing equipment. In addition, if strict separation practices are not maintained, non-GM and organic farmers businesses and reputations can be affected by contamination along the supply chain. These extra considerations add an additional burden onto the farmer.

Ecosystem impacts

Supporters of genetic engineering technologies claim that the new varieties will improve diversity in our diets and our ecosystems. All evidence, however, points to the opposite effect. As of 2015, 33 varieties of GM maize had been approved in the US, which together made nearly 95% of the total area of maize planted that year.

Maize is a crop with a huge amount of genetic diversity. In Mexico, which has resisted the spread of GM crops, family farmers grew approximately 138 billion genetically different maize plants in 2010. The takeover of GM seeds in certain sectors represents a staggering loss of diversity of crops cultivated, and therefore of food eaten.

The negative effects of GM crops on the biodiversity of the wider ecosystem have been widely reported.

Studies have shown that the increased herbicide use on Roundup Ready crops is highly destructive to the natural environment.

For example, Roundup kills milkweed, which is the key food source for the Monarch butterfly and poses a threat to other important insects such as bees. It is also damaging to soil, killing beneficial organisms that keep it healthy and productive and making essential micronutrients unavailable to the plant.

Other types of GM plants, engineered to produce their own insecticide ("Bt" varieties), have also been shown to harm beneficial insects including green lacewings, the *Daphnia magna* waterflea and ladybirds.

Resistance to the insecticides in these plants is also growing, creating new varieties of resistant "superbugs" and requiring more applications of insecticides at different points in the growth cycle, for instance on the seed before it is planted.

In spite of this, new Bt varieties of maize and soy have been approved in the US and will soon be planted.

Which crops have been genetically modified/gene edited?

Due to their commercial potential, GMO development has been largely focussed on the large arable crops – corn, soybeans, cotton and rapeseed.

But at the moment, very few people eat these GM crops directly; instead, they are eaten as ingredients such fats and oils, soya fillers and high fructose corn syrup, which go into a variety of highly processed and snack foods. In addition, about 40% of all GMOs are used to make biofuels that feed cars not people.

A handful of other crops such as potato, papaya, squash, alfalfa, sugarcane and sugar beet have also been genetically modified.

In practice only two gene edited crops have come to market: Cibus's herbicide-tolerant oilseed rape (SU Canola) brings all the same risks as other herbicide tolerant GMOs and Calyxt's soybean with an altered oil profile more favourable to the repeated frying favoured in fast food restaurants.

In Japan, Sanatech Seed's gene edited 'Sicilian Rouge' tomatoes which contain high amounts of gamma-aminobutyric acid (GABA), which has a blood pressure lowering effect, have found a limited market. In the US non-browning apples and mushrooms, approved several years ago, have not yet been commercialised.

The biotech industry blames regulation on the slow uptake of new gene edited crops. But a mixture of complex and incomplete science as well as consumer resistance is a more likely explanation.

Is gene editing different from GMO?

The UK's Genetic Technologies (Precision Breeding) Bill, being debated throughout 2022, is a flagship post-Brexit policy. It breaks the UK away from EU legislation which takes a much more robust approach to the regulation of GMOs, and which requires more comprehensive proof of safety. For more see the factsheet *Gene Editing - What you Need to Know*)

It removes regulatory control from gene edited organisms (which it calls 'precision-bred organisms', or PBOs) which, it contends, could have occurred through "natural transformation" or been created with traditional breeding.

Gene editing is not a specific technology. Instead, it is an umbrella term referring to a range of new genetic engineering techniques that can be applied in plant breeding. It is designed to be more targeted than older techniques but still involves many steps.

We don't have a complete understanding of the genome yet, and each step of this complex and highly invasive process has potential for errors and unintended consequences for our food, for farmers, and for the environment

Supporters of the new UK Bill claim that gene editing differs from genetic modification as it does not involve the insertion of foreign genetic material. In fact, the presence of foreign genetic material is not inherent in the definition of a GMO. The terms GM and GMOs are used in EU regulation to refer to any genetically engineered plant, and the change in meaning is political not scientific.

Additionally, gene editing technologies such as CRISPR often include the insertion of foreign genetic material especially for more complex traits such as drought resistance.

The biotech companies supporting current legislation are the same ones creating GM crops. It is reasonable to predict that farmers will still be prohibited from saving gene edited seed. What is more, while gene editing makes big promises about yields, climate change resistance and higher nutritional value, the first 'new' gene edited crops still focus on the same old traits of herbicide resistance and insecticide production.

What about 'open source' gene edited seed?

Some supporters of gene editing claim they will make the technology for their gene edited crops freely available. History has shown that such promises are not always kept, but even if they are, the seed and resulting plant will still be patented. This means that it is still owned and controlled by the patent owner who can also set the terms giving away to whom, for how long and on what terms.

It is also possible that the biotech companies will give the technology away or make it very cheap in order to create a market. They can then follow-up with other products, like herbicides which are necessary to make the product work properly, and lock farmers into costs and contracts that way. It is notable that one of the first gene edited crops to be deregulated was an herbicide tolerant oilseed rape variety.

Are there any alternatives?

Supporters of industrial farming promote narratives that high-tech, high-yield farming is essential to feed a growing global population, and that corporate seeds, being more predictable and productive, are the only way to prevent mass famine. It can be difficult to challenge this powerful narrative, but growing numbers of farmers and consumers are doing just that by seeking out different approaches to growing and buying their food.

During the coronavirus pandemic demand for local food soared as consumers recognised the fragility of complex supermarket supply chains. Putting a greater effort into shortening and simplifying supply chains would also go some way to reducing food waste. We already produce enough food to feed three billion more people than are currently on the planet. Around 4600 kilocalories per person of food are harvested every day, but only around 2000 are eaten – more than half is lost on the way.

In agriculture, some of the most innovative solutions involve low tech, open source and affordable methods that all farmers and growers can use right now. These include agroecological approaches such as crop rotation, intercropping, soil enrichment and integrated crop and livestock systems.

Agroecology focusses on diversity as an absolutely fundamental part of a healthy ecosystem, and this includes genetic diversity found in seed banks and local farming communities all over the world. This is where we will find the crops which are resilient to climactic and environmental shocks, and this is how we can create a genuinely resilient food system.

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