# Seeds of Resistance

## GMO Deregulation and Grassroots Mobilization


Navdanya international

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## Agriculture needs science: but which science?

In recent times, the public—and especially farmers—have been bombarded with the message that agriculture needs science to face future challenges, including climate change and feeding a continually growing world population.

It's legitimate to ask: what kind of science are we really talking about?
Ecology teaches us that greater diversity means greater productivity (thus: feeding the world) and greater resilience (the ability to recover from events linked to climate change).[1]

The importance of diversity is also highlighted by medicine, which emphasizes the necessity of dietary diversity for a healthy gut microbiome. Our physical health (immune defenses) and mental health (anxiety, depression, youth and adolescent mental discomfort, and eating disorders) depend on this.[2]
Yet this medical guidance is difficult to put into practice, since the food system behind what we eat is based on uniformity.

This is the result of a deep contradiction within the scientific world about biodiversity: a contradiction between the science that supports the importance of biodiversity for food security (and thus health and resilience) and the science of plant breeding, which over the last hundred years has almost exclusively trended towards uniformity.

From this perspective—and regardless of technical differences—GMOs and products of New Genomic Techniques (NGTs) represent the most modern expression of uniformity as the goal of plant breeding.

Thus, the recent debate over whether NGT products are GMOs or not, while legally significant, has distracted attention from the biological reality that both suffer from the same fundamental weakness: they are evolutionarily losing strategies and as such, make farmers—especially organic farmers—more vulnerable.

The main weakness of GMOs and NGT products is that they disregard a fundamental biological law: the Fundamental Theorem of Natural Selection.
This principle, formulated almost a century ago, asserts that when the environment around living organisms changes (let's remember that insects, plant disease fungi, and weeds are living organisms), those organisms, if diverse enough, evolve; only those able to adapt to new conditions survive and reproduce.

Chemical treatments or cultivating a GMO or NGT-resistant variety changes the environment for insects, fungi, and weeds—just as antibiotics change the environment for bacteria that cause disease in humans. The bacteria then develop resistance, posing a major global challenge.

It's important to clarify: it's not the chemical treatment, GMO, NGT product, or—in the case of bacteria—the antibiotic that creates resistance. The resistance is already present as part of the diversity in those organisms; they exploit that diversity, evolving as needed.

Pathology and entomology (other sciences) have long told us that any mechanism for crop pest protection—whether genetic or chemical—can be either stable or unstable. GMOs and NGTs belong to the category of unstable solutions for crop protection. For this reason, they contribute to increasing, rather than decreasing, the uncertainty facing farmers, whose future is already undermined by climate change.

The scientific literature is full of articles documenting the evolution of resistance in the very organisms that GMOs and NGTs target. The most recent, published in February this year by researchers from 12 universities (10 of them American), describes the loss of resistance in a GM maize to an insect pest across 10 states in the US Corn Belt.[3]

In conclusion, GMOs and NGTs are temporary solutions that encourage the emergence of resistant weeds, insects, and fungi, making agriculture even more vulnerable and undermining seed sovereignty, and, consequently, food sovereignty. By contrast, use of biodiversity—recommended by much of the scientific community[4] and applied through crop diversity, intercropping, and the cultivation of mixtures and populations (an approach nearly a century old)—offers farmers a lasting solution, because it prevents the development of resistant weeds, insects, and fungi, and most importantly, it is a solution that cannot be patented.

Despite the scientific evidence, the dominant narrative about the supposed advantages of NGTs is very compelling for a public that largely ignores the complexity of the relationship between DNA and the expression of crucial traits like drought resistance, the ability to withstand climate-related events, and resistance to diseases, insects, and weeds—a relationship in which the environment always plays a critical role, often even more important than that of DNA.

It is therefore urgent to spread as widely as possible what ecology, medicine, and even molecular genetics teach us about the importance of agrobiodiversity—not only as the most cost-effective and efficient tool to combat climate change, but also for fostering a virtuous relationship between agriculture, food, and health, not just for ourselves but for the planet as a whole.

It is also vital to make it known that behind the appealing narrative of what can supposedly be achieved by manipulating DNA, there are many untold truths—truths withheld even from policymakers, who should be among those hearing the message that "this is not the science agriculture needs."

**Salvatore Ceccarelli** [5]

# Seeds of Resistance: GMO Deregulation and Grassroots Mobilization

## Introduction

Across continents, a coordinated shift is underway. Governments are rolling back biosafety regulations, opening the door for a new generation of genetically engineered and gene-edited crops to enter food systems with minimal oversight. This is not only a legal trend but a political one: responsibility for biosafety, food safety, and food sovereignty is increasingly being shifted from public institutions to private actors. A new form of privatisation of law, where contracts and corporate self-regulation replace state-led risk assessments, allows powerful agritech companies to determine the limits of safety, while the costs and risks are externalised to farmers, communities, and ecosystems.

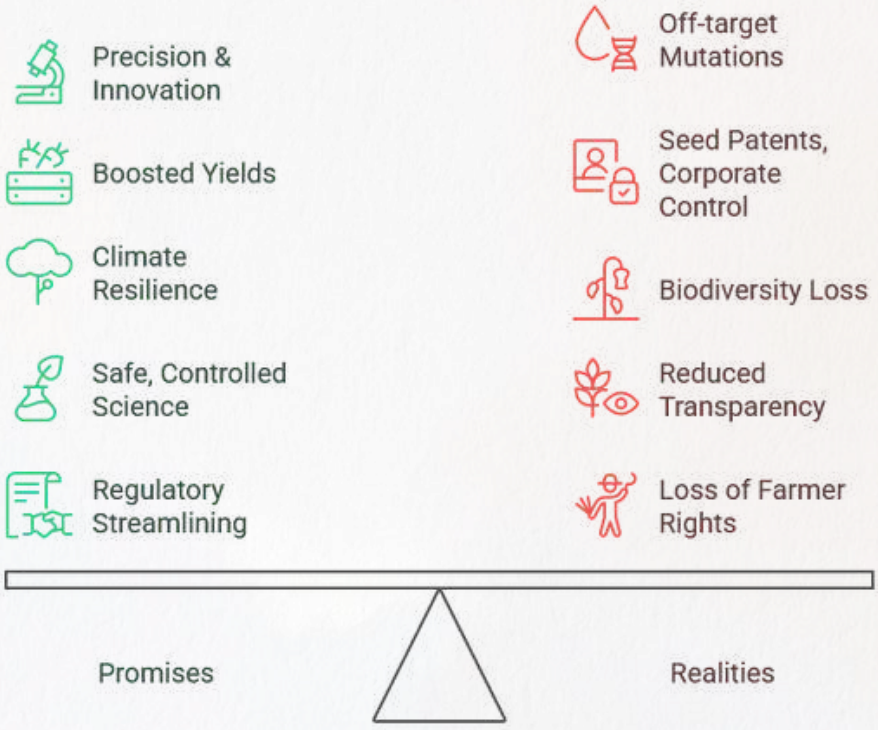
Public concern over GMOs has never disappeared: surveys consistently show resistance to genetically modified foods worldwide. In response, the industry has sought to rebrand. The term new genomic techniques (NGTs) is presented as fundamentally different from GMOs, with the aim to classify crops engineered by NGTs as non-GMO if no foreign DNA is added.

Genetically modification without foreign DNA – despite its powerful intervention on plant genomes – is marketed as natural-like, while criticism about the intentional and non-intentional impact of gene editing through the newer technologies has been raised by different independent scientists and civil society movements globally.

Civil society movements worldwide are raising urgent warnings against the drive for deregulation and expansion of seed patents. They caution that removing safeguards would increase corporate control, foster biopiracy, and undermine biodiversity by promoting uniform, patented seeds. The erosion of seed sovereignty threatens small farmers' ability to save and share seeds, further deepening inequalities. Civil society calls for maintaining full traceability, labeling, and risk assessments for gene-edited crops, closing patent loopholes, supporting community-based breeding, and upholding transparent, participatory governance. These are not only safeguards, but proactive demands to ensure that future food systems remain diverse, just, and democratically controlled.

An expanding base of independent scientific evidence demonstrates that gene editing techniques—marketed as "precise" and "nature-like"—consistently generate a range of unintended and unpredictable genetic changes.

According to multiple peer-reviewed studies, CRISPR and other new genetic engineering (NGT) technologies can cause off-target as well as extensive on-target mutations, chromosomal rearrangements, and genetic instabilities—even when no foreign DNA is inserted. These risks exceed those found in traditional breeding and highlight the need for mandatory, process-oriented risk assessment for all NGT organisms. Independent experts, and the European Food Safety Authority, gene-edited crops fall within the definition of GMOs and must be subject to full regulatory oversight, contrary to corporate claims of naturalness or equivalence to conventional breeding. Still, the so-called 'natural-like' seeds are subjected, just as their older relatives, to patenting. Are these seeds artificial enough to be patented — and therefore not 'natural-like' as claimed — or are we witnessing an attempt to establish property rights over natural seeds and, with them, the very web of life? In both cases, the consequence is the extension of corporate control over ecosystems and food sovereignty, while the public is asked to accept the expropriation of agro-biodiversity and the spread of privately controlled seeds as supposed miracle solutions to hunger, ecological imbalance, and climate change.




At the moment, there is no scientific consensus that is able to claim GMO safety in the international community. Independent research continues to point to uncertainties — from unintended genetic changes to ecological disruptions. The absence of long-term and independent studies highlights the ongoing need for precaution. Therefore, it is now more important than ever to uphold the precautionary principle, which has guided the GMO debate for many years in Europe and elsewhere, safeguarding against unforeseeable but potentially catastrophic consequences of unsupervised and unchecked use of genetic engineering in agriculture and ecosystems.

Over the last years, we saw countries such as Argentina, Brazil, the United States, and Japan moving to exempt many gene-edited crops from the risk assessments and labeling requirements applied to earlier GMOs. These frameworks are presented as “precision breeding,” yet their practical effect is a dramatic weakening of biosafety regimes. By treating NGTs as fundamentally different from GMOs, regulators are lowering the barriers for corporate control of agriculture, while sidelining public scrutiny.

Latin America illustrates how quickly these dynamics are advancing. Argentina was the first country to establish a fast-track approval process for gene-edited crops, and Brazil, Paraguay, Uruguay, and Colombia quickly followed. These policies were shaped under strong pressure from biotech lobbies and promoted as tools for economic growth and climate adaptation. In practice, they accelerate deregulation and market entry, while raising unresolved questions for biodiversity, small farmers, and food sovereignty.

As biotech corporations and industrialized governments push for the deregulation of genetically modified organisms (GMOs) and gene-edited crops, a parallel and potent resistance is rising—led not by states or corporations, but by farmers, indigenous peoples, and civil society movements. Across the world a powerful wave of grassroots organizing is challenging the narrative that gene technologies are the inevitable future of food.

Alongside the wave of deregulation and technological rebranding, communities globally continue to practice and defend farmer-led plant breeding—a system grounded in millennia of ecological intelligence, diversity, and collective stewardship. Traditional seeds, collaboratively selected and saved by generations of small-scale farmers and indigenous peoples, embody resilience: they adapt to and heal local ecosystems, foster food sovereignty, and nurture cultural memory, standing in sharp contrast to the logic of privatization and genetic uniformity at the heart of industrial agriculture. This living heritage affirms that true innovation emerges from reciprocal relationships with nature, care for the commons, and the creative evolution of seeds in farmers’ hands.

This growing divide reflects a political fault line: for governments and corporate lobbyists, the deregulation of GMOs is framed as "innovation" and "climate resilience" necessary to improve crop yield, with minimal oversight and corporate-led research. However, at the grassroots level communities are defending their right to seeds, food sovereignty, and ecological knowledge rooted in ancestral memory through vocally resisting these new technologies and impositions.

While Europe relaxes its regulatory frameworks to accommodate new gene editing technologies, Latin American nations like Mexico and Peru are doubling down on constitutional protections for native seeds. In Asia, courtrooms are becoming arenas of resistance—as seen in the Philippines, where farmers won a landmark case against the release of genetically modified rice and eggplant.

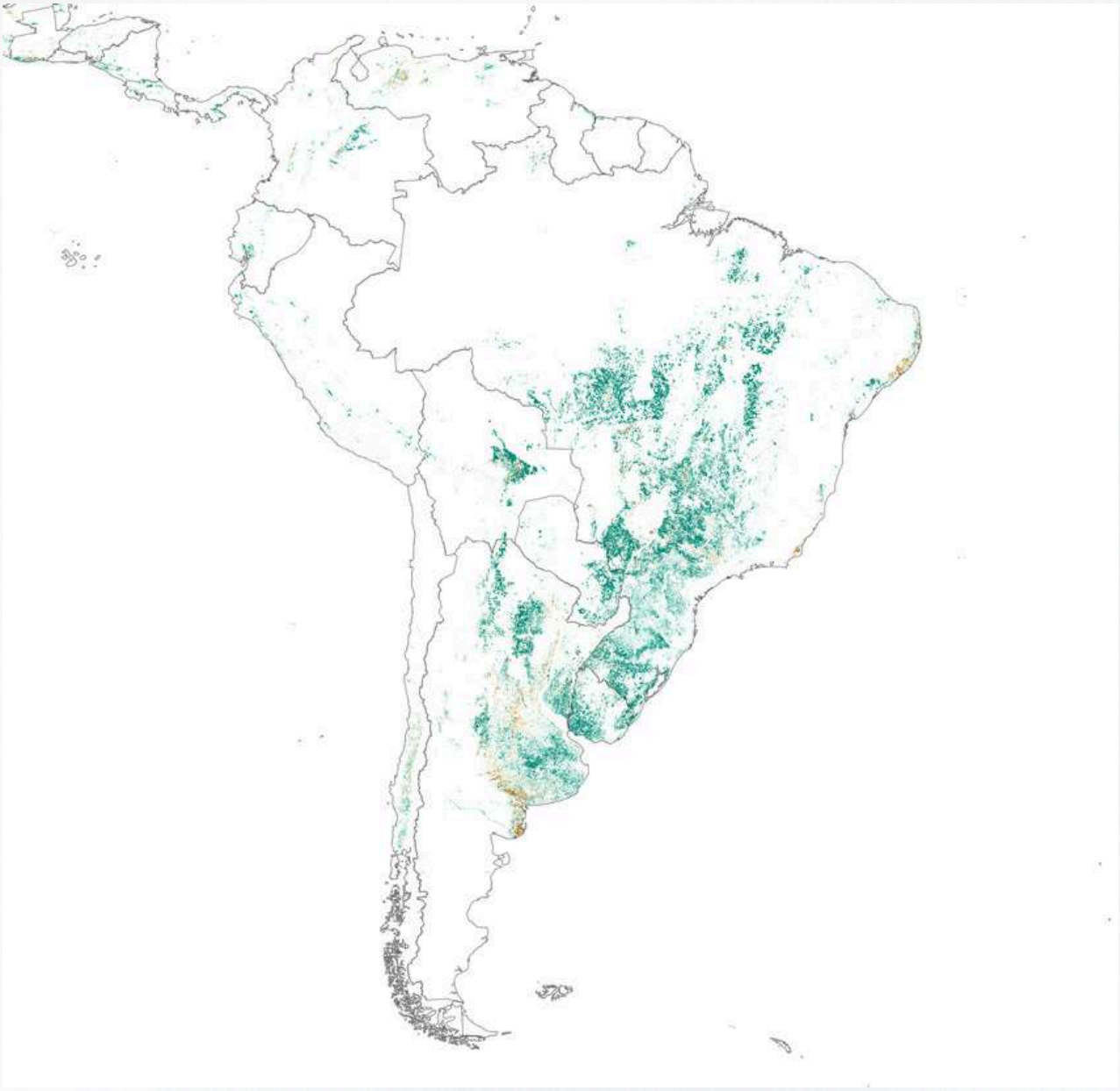
While much of the current debate is framed around new genomic techniques, these often function as a smokescreen for broader deregulation. Industry narratives use the promise of precision and innovation to justify weaker oversight, but in practice the contested cases are frequently those of first-generation GMOs such as HB4 wheat, GM Maize, Bt eggplant, and many others. Grassroots opposition and civil society critique have therefore not only targeted new technologies but consistently raised concerns about the deregulation of these older GMOs. As we will see in the following chapters, this dynamic exposes the inconsistencies in how deregulation is promoted and the interests it serves.

This report provides a snapshot of the shifting political landscape around GMOs and recent victories in civil resistance. It reveals how the real innovation lies not in laboratories but in the living, breathing systems of biocultural care being upheld across the world.

## Latin America – The Frontlines of GMO Politics

Latin America stands at the epicenter of the global GMO debate—a continent where the struggle over genetic technologies in agriculture is especially visible, intense, and consequential. Since the 1990s, the region has been a testing ground for corporate-driven biotechnology: Argentina and Brazil became global leaders in GM soy, maize, and cotton, pioneering regulatory models that prioritize rapid market approval, minimal oversight, and alignment with multinational agribusiness. This embrace of biotech has made Latin America synonymous with industrial monocultures, heavy pesticide use, and deep integration into international commodity chains.

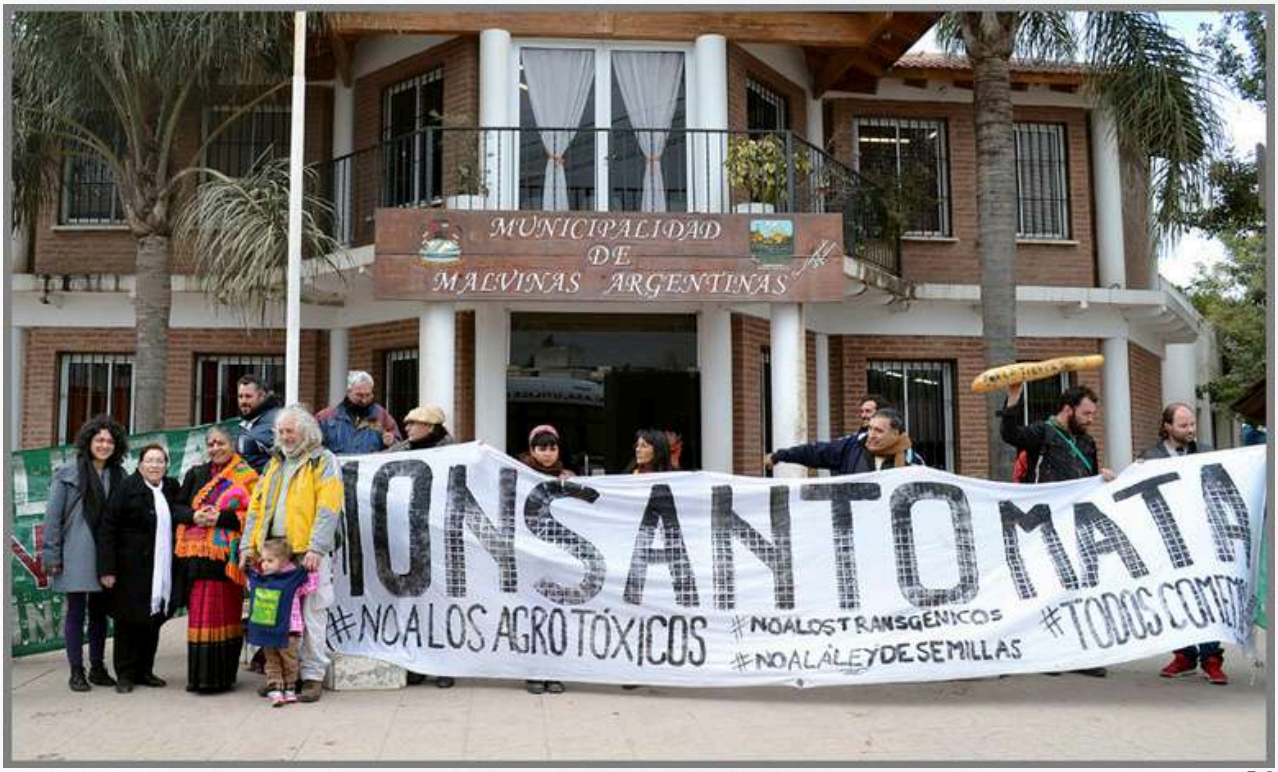
### The Spread of Soy in South America



Yet, the continent also boasts some of the world's most passionate, organized, and visionary resistance. From Andean countries with long-standing moratoria on GM crops, to historic grassroots mobilizations that overturned the "Monsanto Law" in Guatemala, to Mexico's recent constitutional reform safeguarding maize as biocultural heritage, and constitutionally enshrined seed bans in Ecuador and Venezuela, Latin America has charted innovative paths in defense of food sovereignty. Social movements—rooted in Indigenous, campesino, and ecological traditions—have made the defense of seeds, biodiversity, and collective rights central to national identity and policy.

The frontlines have shifted with the arrival of new genomic techniques (NGTs) and gene editing. Here, the political landscape remains as polarized and influential as ever. While a growing "Argentina model" is promoted—exempting many gene-edited crops from traditional GMO regulations—movements and progressive governments across the region are fighting to uphold precaution, biosafety, and the cultural commons. International trade agreements, transnational biotech lobbying, and escalating climate pressures add further layers of complexity.

Latin America is not only the world's most dynamic battleground for GMO and gene-editing regulation, but also a generator of alternative approaches—ranging from "laboratories of deregulation" to constitutional protections for native seeds. Nowhere else is the question of who owns, controls, and defines the future of food so deeply entwined with questions of national sovereignty, cultural rights, and ecological survival.



**Argentina & Brazil: Corporate Capture Meets Civil Pushback**

Two of the world's leading GMO producers, Brazil and Argentina are quickly moving toward deregulation. Both countries now allow gene-edited crops to bypass traditional GMO safety evaluations if they do not contain foreign DNA. This regulatory sleight-of-hand has opened the floodgates for new biotech products to enter markets without clear oversight, labeling, or public participation. Making it almost impossible to know what seeds, or crops have been gene edited.

The recent introduction of HB4 transgenic wheat, developed by the company Bioceres in collaboration with Bayer, has also sparked resistance. While it is marketed as drought-resistant, scientists and farmers have raised concerns over its safety, glyphosate resistance, and the potential contamination of native wheat varieties, particularly in Argentina. Civil society groups—including the international alliance "No al Trigo Transgénico"—have petitioned the UN for an urgent intervention and called for a permanent suspension of HB4 wheat cultivation and commercialization.

The battle over GM wheat is emblematic of a deeper pattern: bread, a staple food, is being turned into a vehicle for speculative biotech profit. In both countries, farmers' voices have been sidelined, and the burden of proof shifted away from biotech developers. But the resistance is growing, from agroecological networks to legal campaigns challenging regulatory loopholes, with GM wheat being banned in the Argentinian province of Buenos Aires in 2022.

Argentina's approach to gene-editing regulation, commonly known as the "Argentina model", has been in place since 2015. This model employs a product-focused, case-by-case framework whereby crops edited without introducing foreign DNA are not classified—or regulated—as GMOs, thus fast-tracking their development and commercialization. Regulatory updates, including Argentina's Resolution 21/21 from 2021, have further consolidated this practice and influenced the harmonization of regional regulations.

Brazil has adopted similar standards through its National Technical Commission on Biosafety (CTNBio). Under a 2005 biosafety law, gene-edited products that do not involve foreign DNA are assessed mainly for their end characteristics and are largely exempt from GMO oversight. This deregulatory trend has supported the rapid entry of various biotech products into the markets of both countries, including notable cases beyond crops (e.g., the approval of gene-edited hornless cattle in Brazil in 2018).

Beyond technical regulation, both governments have worked towards mutual policy alignment through agreements such as a Memorandum of Understanding (MOU), seeking to accelerate authorization processes and reduce barriers to regional agri-biotech trade.

However, this drive to facilitate innovation has escalated conflicts over biosafety, transparency, and community participation in both countries. The HB4 wheat case epitomizes the social and political fallout of these regulatory shortcuts. Citizens, agroecological networks, and legal alliances argue that the deregulation serves corporate interests and undermines agro-biodiversity, biodiversity, food security, and farmers' rights, while supplanting participatory science-based assessment with industry-driven approvals.

Thus, while Argentina and Brazil are showcased in industry circles as models of "pragmatic" gene-editing governance, their approach remains hotly contested. Advocates for agroecology and public oversight continue to push for comprehensive risk assessment, transparency, and regulation that centers local farmers, biodiversity, and the public good.

## HB4: Drought Tolerant Transgenic Traits in Wheat

HB4 Wheat (IND-ØØ412-7 seed) is a first-generation transgenic wheat developed by Argentinian company Bioceres. It contains the sunflower's (Helianthus annuus*) HaHB4* gene, which claims to increase drought resistance, and the *bar* gene, which encodes for tolerance to glufosinate-based herbicides. The genetic traits are introduced by microparticle bombardment of plant cell tissue, a technique used also for Bayer's (formerly Monsanto's) Round Up Ready Maize.

At the moment, Hb4 wheat is grown in Argentina and Brazil, whereas it is imported for food and feed in Australia, Colombia, Indonesia, New Zealand, Nigeria, Paraguay and the United States. In August 2022, HB4 was introduced in South Africa for food and feed; efforts to initiate field trials for growing HB4 by Trigall Genetics SA were heavily objected to by the African center for Biodiversity.

Regulatory Approvals: Country, Year and Type of Approval

| Country | Food<br>direct use or processing | Feed<br>direct use or processing | Cultivation<br>domestic or non-domestic use |
|---|---|---|---|
| Argentina | 2020 | 2020 | 2020 |
| Australia | 2022 | 2022 | |
| Brazil | 2021 | 2021 | 2023 |
| Colombia | 2022 | 2022 | |
| New Zealand | 2022 | 2022 | |
| Nigeria | 2022 | 2022 | |
| Paraguay | 2023 | 2023 | 2023 * |
| United States | 2022 | 2022 | |

In an urgent appeal to the United Nations, civil society organizations from Latin America, Africa, and Asia denounce the commercial and climate-related failure of transgenic traits claiming drought tolerance. They stress that there is no concrete evidence proving the effectiveness of these traits, while warning of numerous negative side effects and risks, including cross-contamination and the erosion of agrobiodiversity.

The appeal recalls past failures in fulfilling promises of drought tolerance, such as in GM maize MON 87460 and HB4 soybean. The organizations also highlight that the wheat yield of HB4 is "very low—2.42 tons per hectare," citing figures from the Argentine Ministry of Agriculture.

Concern is also raised regarding the genetically added tolerance to glufosinate ammonium, a herbicide banned in the European Union since 2018 due to its toxicity.

The increased use of herbicides associated with HB4 cultivation is expected to have negative impacts on food safety and working conditions, and to contribute over time to biodiversity loss, desertification, and water pollution. Such effects risk exacerbating drought and climate-related challenges rather than mitigating them. Generally, the exact function of the HaHB4 gene is not fully understood yet.

Microparticle bombardment, just as Agrobacterium tumefaciens infection, are first-generation techniques of gene editing still widely in use, but considered highly mutagenic. The frequency of transformation-induced mutations and their importance as potential biosafety hazards are poorly understood.

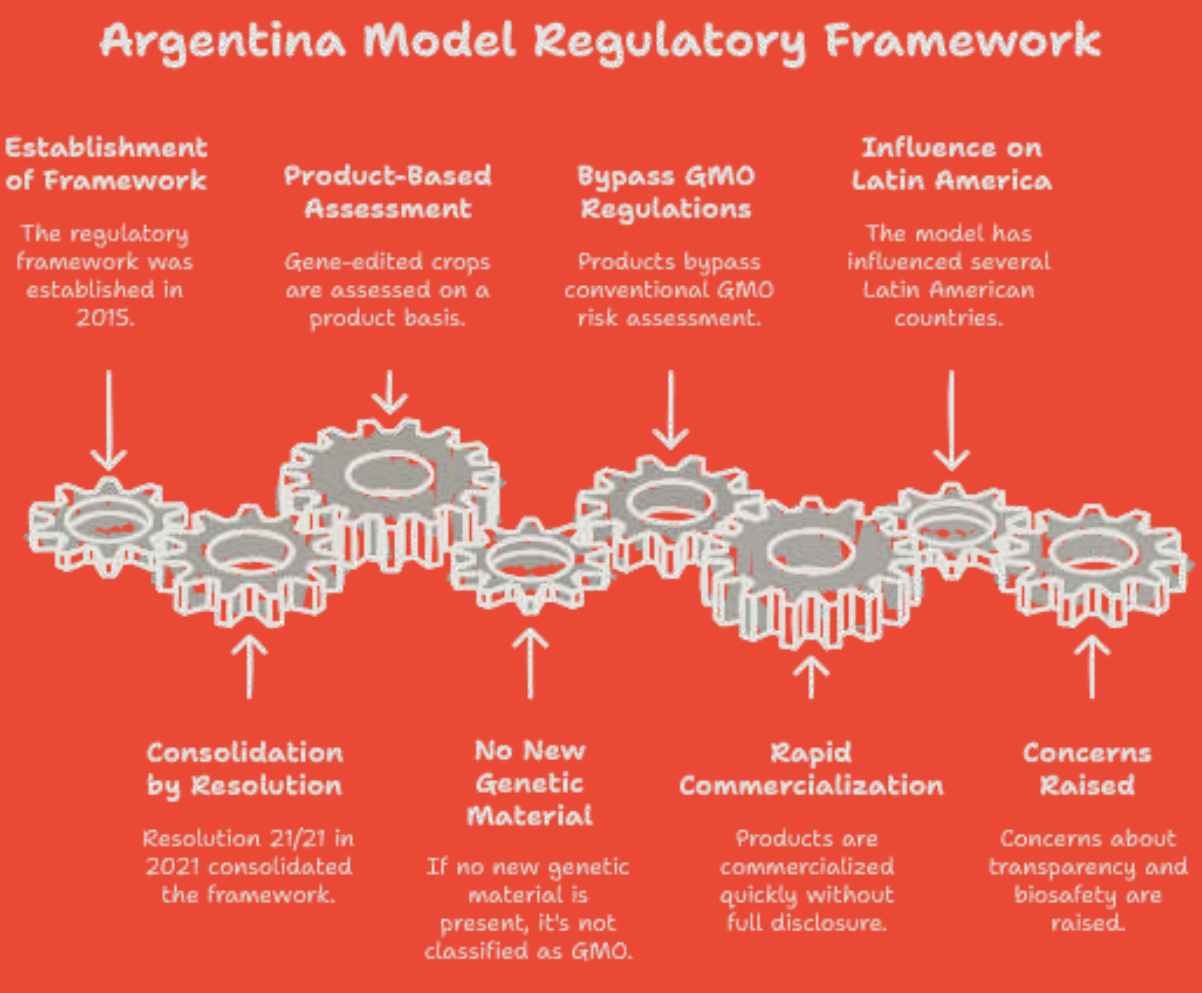
## What is the Argentina Model?

The "Argentina Model" is a regulatory framework, established in 2015 and consolidated by Resolution 21/21 (2021), that assesses gene-edited crops and new breeding techniques (NBTs) on a case-by-case, product-based basis rather than process-based.

Under this system, if a genetically modified organism (GMO) or gene-edited product does not contain a “new combination of genetic material”—meaning no foreign DNA has been inserted—it is not classified or regulated as a GMO.

This allows such products to bypass conventional GMO risk assessment, labeling, and traceability requirements, facilitating rapid commercialization without full public disclosure or long-term biosafety evaluation.

The Argentina Model has influenced several Latin American countries and opened the door for many gene-edited and biotech crops to enter markets with minimal oversight, accelerating regional policy harmonization while raising concerns about transparency, biosafety, and the erosion of seed sovereignty



**Bolivia: A Cautious Opening to GMOs**

Once considered a stronghold of seed sovereignty under the "Law of Mother Earth", Bolivia has begun a quiet shift. Since 2022, the country has introduced legal openings for GMO production of soy and cotton—primarily for export—while maintaining a formal ban on GMO use in native crops. But while the formal ban has remained, farmers and movements in Bolivia have begun to report the cross contamination of native corn varieties with GMOs.

However, resistance remains strong in indigenous territories and among environmental defenders who view the move as a violation of Bolivia's constitutional principles. Civil society continues to advocate for the protection of native biodiversity and traditional farming systems, warning that this creeping deregulation endangers both ecosystems and cultural lifeways.

This policy shift was set in motion during the interim Áñez government with Supreme Decree 4232 in 2020, which sought to fast-track approval processes for GM maize, sugarcane, cotton, wheat, and soy. The decree drew immediate backlash from civil society: On June 23, 2020, artists and environmental groups launched a "plantón cultural"—a cultural sit-in with the song Nos habla el maíz ("The corn speaks to us")—and invited indigenous farmers to articulate the risks posed by GM seeds.

In July 2022, producers from the Integrated North of Santa Cruz blocked the highway between San Pedro and Montero and closed off access to the silos of the state grain company EMAPA, after discovering trucks transporting transgenic corn for government storage. During this same confrontation, local farmers also detained MAS senator María Muñoz at the EMAPA entrance, directly accusing the company and authorities of handling illegal GM maize.

These actions underscored the well-documented concerns and tangible evidence raised by grassroots organizations and movements: not only about contamination of staple crops, but also regarding government accountability and the failure of officials to implement transparent testing of the corn. The episode reflected widespread distrust of official oversight and highlighted accumulating reports of unapproved GM seeds spreading in Bolivia's principal agricultural region—all against the backdrop of rising tensions over recent legal openings for GMOs.

Civil society action only intensified in the following years. In September 2023, environmental organizations presented a public letter to Vice-Minister Magín Herrera protesting the authorization of INIAF (National Institute of Agricultural and Forestry Innovation) to develop new GM events—arguing this violated both the Constitution and the Law of Mother Earth due to the lack of Biosecurity Committee involvement.

By August 2024, agroecology groups were urging a full halt to GM seed trials, exposing how contraband seeds and agro-industry pressures were spreading GM maize—undermining biodiversity, yields, and even driving new waves of deforestation.

Throughout, indigenous communities have insisted that these regulatory changes and market pressures are not just legal issues but fundamental threats to nature and culture. Bolivia's ongoing deregulation process has galvanized a vibrant defense movement that links seed sovereignty not only to ecosystem protection but also to the heritage and autonomy of its people—a struggle that continues as GM pressures mount.

*World People's Conference on Climate Change and the Rights of Mother Earth 2010*

**Costa Rica: Regulatory Shifts and the Ongoing Struggle**

Until very recently, Costa Rica's biosafety regime subjected all genetically modified organisms—whether classic transgenic GMOs or crops altered by modern gene editing techniques such as CRISPR—to the same legal process. All were treated as GMOs, requiring rigorous biosafety assessments, official permits, and authorization before environmental release or commercialization, in line with the country's Phytosanitary Protection Law and its commitment to the precautionary principle.

However, a major regulatory change came in November 2023 with the publication of Executive Decree 44244-MAG. For the first time, Costa Rica's government established a clear legal distinction between "old generation" GMOs (conventional transgenics with stable, novel combinations of genetic material) and many "new generation" gene edited crops. Under the revised rules, gene edited crops that do NOT contain a "novel combination of genetic material"—that is, crops whose genetic changes could, in principle, also be produced by conventional breeding—are now officially considered equivalent to conventional crops and are exempt from GMO regulation. Only those gene edited organisms that contain new combinations of genetic material not possible through traditional breeding (for example, insertions of foreign genes or complex multi-site edits) remain classified and regulated as GMOs.

This means that many new gene edited crops—with small targeted mutations, deletions, or traits that could arise "naturally" or via traditional crosses—are now able to avoid the oversight, public consultation, and risk assessment traditionally associated with GMOs. The regulatory approach closely resembles that of Brazil and Argentina, where a product-based test, rather than a process-based test, defines GMO status.

This change arrives in a country with a long and hard-fought legacy of resistance to transgenic GMOs. Costa Rica has been a Latin American leader in grassroots mobilization against GMO cultivation and agroindustrial monocultures, driven by peasant, Indigenous, women's, and environmental organizations. Many municipalities declared themselves "GMO-free zones," halting the spread of transgenic maize and orchestrating legal battles against the expansion of genetically modified—and particularly pesticide-intensive—crops such as pineapple. Yet, environmental activism in Costa Rica has come with real costs. Environmental defenders have faced violence, legal persecution, intimidation, and even murder, much of it linked to struggles around agricultural expansion.

Costa Rica also has a notable tradition of agroecology as both a practice and a movement.

Agroecological farming—supported by campesino, Indigenous, and environmental networks—emphasizes seed autonomy, local food systems, and resistance to monocultures and dependency on chemicals and external inputs. These grassroots agroecological initiatives are seen as a daily practice of sovereignty and ecological stewardship, offering concrete alternatives to agroindustrial models. Organizations and coalitions have been active not only in defending land and seeds from transgenics, but also in promoting policies and knowledge exchange to scale up agroecological production and embed it as a resilient pillar of food sovereignty.

While Costa Rica has a long legacy of grassroots campaigns and legal challenges against transgenic GMOs, there is, as of yet, limited evidence of comparable mobilization or public campaigning specifically addressing the deregulation and regulatory exemption of gene edited crops introduced by Executive Decree 44244-MAG in November 2023. For example, in June 2025, environmentalists organized protests and brought legal action concerning the authorization of genetically modified maize, once again focusing national attention on transgenic crops and associated biosafety issues. Awareness and debate around this policy change may increase as gene edited products near commercialization.

## Banana: Monoculture Crisis, Biofortification, and Seeds as Commons

Banana is at the center of two major, transnational controversies in agri-biotech: the "monoculture crisis" of Cavendish, the world's most widely traded banana, made vulnerable by genetic uniformity; and efforts to engineer or biofortify bananas—especially for Vitamin A—through transgenics or gene-editing, promoted as solutions to public health and disease problems from Uganda to Australia. Both cases, far from being simple technical advances, open profound questions about the future of seed diversity, biopiracy, food systems, and farmer autonomy.

### *The Cavendish Crisis: Monoculture Vulnerability and Biotech "Fixes"*

Over 40% of global banana production relies on one variety: Cavendish, grown in vast monocultures and genetically identical across continents. This lack of diversity has left the global banana trade highly susceptible to disease, most urgently Fusarium wilt Tropical Race 4 (TR4), a fungal disease spreading uncontrollably from Asia to Africa and Latin America. Cavendish's uniformity means that once a disease emerges, it can threaten the world's supply—causing billions in projected losses and deepening reliance on agrochemicals. Biotech research (notably in Australia and Costa Rica) promotes GM (QCAV-4) and gene-edited Cavendish as disease solutions.

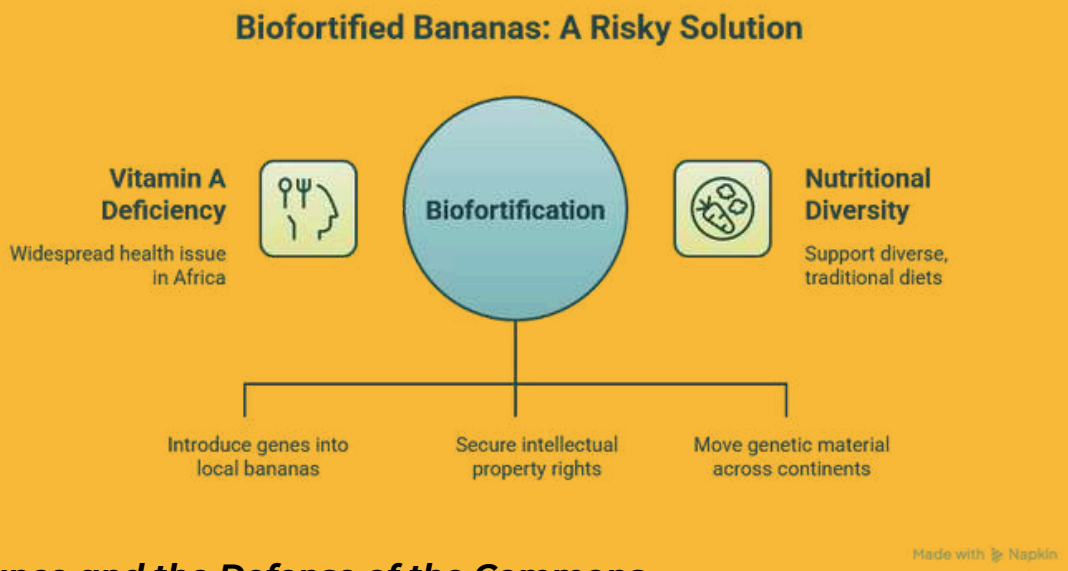
*Organic agroforestry system with plants of Gros Michel banana, cocoa, pejibaye, etc.*

Critics point out these approaches repeat the monoculture logic and risk corporate enclosure of banana genetics. Agroecological alternatives exist: In Costa Rica, farmers have maintained local diversity through "Gros Michel" and other traditional varieties, using mixed cropping and organic practices to restore disease resilience and farmer sovereignty.

***Biofortified and Gene-edited Banana: The Golden Promise and Its Perils***

In Africa and Australia, "golden banana" projects—using GM or gene-editing—aim to combat Vitamin A deficiency by transgenically enhancing local bananas with genes from Papua New Guinea (notably the Banana21 project of QUT and Ugandan institutes, funded by Gates Foundation). These biofortified bananas, framed as public health solutions, are subject to patent claims and global South-North gene transfer.

Critics—from farmer organizations in Indonesia (source of key genes) to African agroecological networks—warn that these efforts ignore locally adapted food systems and knowledge, and risk further enclosure and dependence, instead of addressing nutritional diversity by supporting diverse, traditional diets.




***Resistance and the Defense of the Commons***

Transnational resistance has emerged around both issues:

- In Australia, Indonesia, and Africa, campaigns warn that gene/trait patents amount to biopiracy, threatening local sovereignty and biodiversity.
- Farmer, Indigenous and women's groups globally advocate for seed commons, diverse and resilient agrobiodiversity, and participatory research as the real solutions to hunger and disease.

The saga of the banana demonstrates the risks of monoculture thinking—whether via conventional or "high-tech" means—and highlights the crucial role of biodiversity, local knowledge, and food culture in sustaining the world's most beloved fruit.

**Peru, Ecuador, and Venezuela: Islands of Resistance**

Across Latin America, several countries have taken remarkably strong legal and social measures to defend seed sovereignty and biodiversity against genetically modified organisms (GMOs).

Peru, Ecuador, and Venezuela stand out as three nations that have resisted the global trend of biotech expansion, creating unique legal frameworks rooted in the defense of community rights, farmer knowledge, and ecological integrity. Far from "falling behind" in innovation, they illustrate how agricultural policy can prioritize biodiversity, resilience, and social participation over patents and corporate control.

**Peru** has upheld one of the longest moratoriums on GMO cultivation, recently extended until 2035. First enacted in 2011, the moratorium restricts the production, import, and commercialization of GMOs with the aim of safeguarding native crops and food sovereignty.

The law emerged after years of mobilization led by indigenous peoples, farmer unions, and environmental organizations, who recognized the country's role as a vital center of origin for crops like potato, maize, and quinoa. These movements have continued to sustain the moratorium through national campaigns and local organizing, exemplified by the successful effort in Cusco to ban GM potatoes, citing risks of contamination and threats to unique native varieties.

When it comes to gene editing, Peru has adopted a strict precautionary approach: gene-edited organisms are considered within the scope of existing GMO prohibitions and subject to the same regulatory restrictions as transgenic crops. The law's language and enforcement practices explicitly cover all genetically engineered organisms, including those developed by new genomic techniques, and there is currently no legal pathway for commercial gene-edited crops outside research or specific exceptions. As a result, Peru's policy has drawn praise from farmer organizations and from scientists warning about the risks of off-target effects and biodiversity loss.

Beyond legal prohibitions, grassroots strategies focus on community seed banks to conserve native species and promote agroecological farming. Reports emphasize the crucial function of the moratorium in defending "agrobiodiversity, ancestral knowledge, and sustainability." While enforcement is repeatedly challenged by corporate lobbying and roll-back attempts, civil society continues to champion the policy as a cornerstone in the protection of biodiversity and resilient farming economies.

**Ecuador** offers a distinct approach by embedding its ban directly into national constitutional law. Article 401 of the 2008 Constitution explicitly prohibits GM crops, positioning Ecuador among the only countries globally to enshrine seed integrity in its constitution. This move made food sovereignty a constitutional guarantee and linked farming with fundamental rights.

In recent years, however, Ecuador has faced recurring debates about gene-edited crops and pressure to exempt new genomic techniques (NGTs). Some actors, including regulatory agencies, propose legal interpretation that would allow certain gene-edited organisms not containing foreign DNA.

Yet farmer movements, indigenous confederations, and environmental organizations remain vigilant against any weakening of constitutional bans. They argue that relaxing restrictions for gene editing would erode farmer rights, increase risk to the country's crop diversity, and open the door to monopolies and biopiracy. Ecuador's networks insist that only robust frameworks can reinforce sovereignty and ecosystem resilience. The regulatory future of gene editing in Ecuador is thus hotly contested and remains under debate, with precaution and public participation driving advocacy.

In **Venezuela**, resistance to GMOs crystallized in the landmark 2015 Seed Law, which strictly prohibits GM seeds and explicitly promotes agroecological systems and peasant-managed seed networks. Uniquely, the law bars seed privatization, rejects patents, and affirms that seeds belong to the people. Local innovation and knowledge are recognized as central to food security and ecological defense. In legislative practice, Venezuela subsumes gene-editing approaches within the existing definition of GMOs, thereby subjecting them to the full spectrum of prohibitions and approvals in the Seed Law. No separate pathway for commercial release or fast-track exemptions has been documented, and policy continues to prioritize precaution and sovereignty despite economic and political challenges.

Together, these three nations articulate a profound counter-narrative to the portrayal of biotech "absence" as underdevelopment. Through legal bans, moratoriums, and grassroots practice, they have carved out pathways where agricultural futures are shaped by biodiversity, social participation, and ecological resilience. By embedding these principles into constitutions, laws, and communal strategy, Peru, Ecuador, and Venezuela defend the commons against commodification and resist speculative genomic technologies. Far from stagnating, they are charting a vision for agriculture rooted in diversity, sovereignty, and collective rights.

**Colombia: Shifting Biosafety, Local Resistance, and the Battle Over Seeds**

Colombia has long maintained a structured regulatory system for GMOs, anchored by Decree 4525 (2005) and overseen by interagency biosafety committees, including the Ministry of Environment, Ministry of Agriculture, and the Colombian Agricultural Institute (ICA). For gene edited crops, the regulatory regime increasingly relied on a case-by-case assessment: since 2018, products of gene editing (such as those produced by CRISPR) could be exempted from GMO regulations if they did not contain foreign DNA and were deemed equivalent to conventional crops—the ICA determined regulatory status upon developer application. Gene-edited plants without transgenes, after regulatory review, were repeatedly allowed to bypass the full GMO approval process and were treated as non-GM for cultivation and commercialization.

However, this permissive approach has recently come under renewed scrutiny. In February 2025, the Colombian Constitutional Court upheld new legal protections, including a sweeping legislative ban on genetically modified seeds. Crucially, this ban explicitly applies to all seeds whose genetic material has been altered using modern biotechnology, following the definition set by the Cartagena Protocol. This means that, as of this reform, both classic transgenic seeds and gene-edited crops (including those produced by CRISPR and similar techniques, regardless of the presence of foreign DNA) are comprehensively banned from importation, cultivation, commercialization, and export in Colombia. The new legislation closes previous regulatory loopholes that allowed certain gene edited crops to be exempted on a case-by-case basis, marking a shift toward a unified and precautionary approach to all genetically modified seeds.

Colombia first approved GM cotton in 2002 and GM maize in 2007, with commercial cultivation expanding rapidly after these dates. By 2019, over 100,000 hectares of transgenic crops (mostly maize and cotton) were grown annually, with significant imports of GM corn and soy. Resistance emerged early: peasant, Indigenous, and environmental groups criticized the regulatory framework for failing to protect native agrobiodiversity and farmer rights, and for insufficient consultation with local communities. Court rulings in 2015 and later highlighted these concerns, mandating stricter biosafety standards for native seeds and responding to Indigenous legal actions for seed protection.

One of the most emblematic casesis the municipality of San Lorenzo in Nariño. Here, a coalition of “seed guardians”—farmers, rural and Indigenous leaders, environmentalists—mobilized when GM seeds were detected in local fields in the early 2010s.

Through local referenda, public campaigning, and partnership with the national “Seed Guardians of Life” network and NGO Grupo Semillas, San Lorenzo declared itself a GMO-free territory in 2018. This declaration, legally recognized by the municipal government, set a precedent for other municipalities and Indigenous territories; similar local bans have now been adopted in La Unión, Riosucio, and among the Zenú people. These actions directly challenged commercial seed companies and triggered legal pushback from national agribusiness groups, but have been sustained as models of participatory, democratic resistance to GM crop expansion. National organizations such as Grupo Semillas continue to advocate for constitutional protections for native seeds and strict limits (or outright bans) on the use, import, or sale of GM seeds in Colombia.

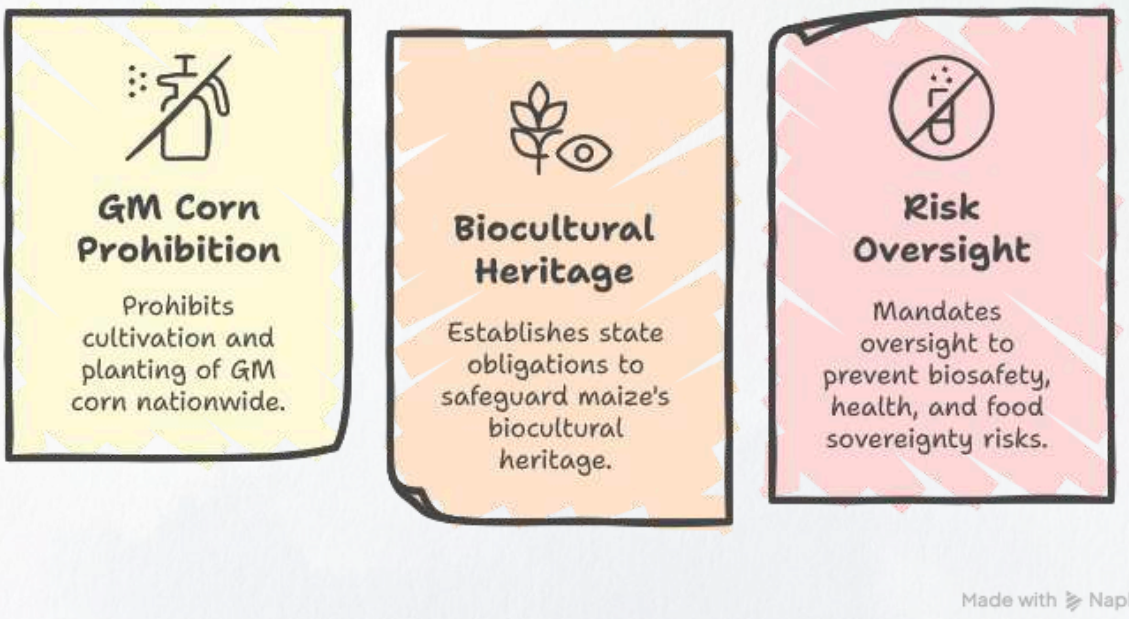
Colombia’s regulatory debate now stands at a crossroads. While the central government’s biosafety policy previously enabled rapid approval (and in some cases, deregulation) of gene edited crops on a case-by-case, product-based basis, powerful local and national resistance efforts—backed by recent court decisions and growing political support—are driving a new legislative movement to ban genetically modified seeds altogether. Biodistricts like San Lorenzo in Nariño provide living laboratories for farmer-led, GM-free agriculture, echoing a wider Latin American trend toward seed sovereignty, municipal autonomy, and grassroots agroecology.

**Mexico: Legal Resistance as a Global Precedent**

Mexico is the most recent hotspot in the global GMO debate. In 2020, the government issued a decree to phase out genetically modified corn and glyphosate. Mexico's stance is especially significant as the country is the center of origin and diversity for maize, a crop with immense ecological, agricultural, and cultural importance. The 2020 presidential decree marked an unprecedented policy shift, seeking to gradually phase out both genetically modified corn and the herbicide glyphosate specifically to protect maize biodiversity, farmers' livelihoods, and public health. The ban aimed to target imports for food and animal feed: tortillas, tamales, and other staples central to Mexican diet and culture.

This decision immediately provoked a trade dispute with the United States, which formally challenged Mexico's restrictions on the basis of the USMCA/T-MEC, insisting the ban was "unscientific" and harmed American corn exports. In 2024, a dispute panel ruled against Mexico, and the Mexican government was forced to temporarily lift the ban on GM corn imports.

Although compelled to temporarily lift import restrictions after the panel ruling, Mexico swiftly responded by deepening its protection of maize through a watershed constitutional reform in early 2025. With broad legislative approval, Congress amended Articles 4 and 27 of the Constitution to: prohibit cultivation and planting of GM corn nationwide, establish state obligations to safeguard the biocultural heritage and biodiversity of maize, mandate oversight to prevent biosafety, health, and food sovereignty risks.



President Claudia Sheinbaum hailed this as a historic affirmation of Mexican sovereignty and cultural identity. The reform was quickly ratified and published in the federal register, making any secondary laws that conflict with it subordinate.

The scientific rationale for this ban is rooted in concerns about the irreversible contamination of native maize. Experts like Charles Benbrook, alongside Mexico's National Council of Humanities, Sciences, and Technologies (CONAHCYT), warn that transgene flow could erode the genetic diversity of Mexico's thousands of native maize varieties, severely undermining climate and disease resilience and food sovereignty. These concerns are thoroughly substantiated by CONAHCYT's 2024 Dossier, which reviewed over 1,200 scientific studies and conducted extensive molecular analyses, revealing the presence of transgenes in up to 33% of native maize accessions in certain states. This empirical evidence confirms that transgenic contamination is not a distant risk but a current, escalating threat—providing a clear justification for robust legal protection of Mexico's biocultural maize heritage.

Mexican civil society has led and shaped these processes at every stage. The movement "Sin Maíz, No Hay País" and national alliances have campaigned not just through protest and education but by pursuing innovative legal strategies. After the T-MEC ruling, a collective lawsuit by grassroots groups was upheld, allowing Mexico to counter-sue the US for failing to account for scientific evidence on the harm of GMOs and glyphosate.

Local organizations demand robust biosafety oversight, transparency, and the continuing privileging of indigenous knowledge and agroecological practice over industrial biotech farming.

Mexico's struggle has global implications, raising vital questions about food and seed sovereignty under free trade agreements. The constitutional protection of maize—enshrined by law as a living heritage of the nation—offers a powerful model: defending not just crops, but a civilizational legacy built on biodiversity, collective rights, and sustainable farming.

**Guatemala: Seeds as Cultural Defense**

In Guatemala, indigenous organizations are building a grassroots defense of food sovereignty through cultural action. Local networks have organized native seed markets as spaces of resistance—both economic and symbolic. These community events not only preserve genetic diversity but serve to denounce the covert introduction of GMOs into national food systems.

Indigenous organizations are at the forefront of vigorous resistance in Guatemala, anchoring their activism not only in food production but in cultural identity and ecological stewardship. Although Guatemala has no formal national ban on GMOs, grassroots movements have effectively maintained a de facto moratorium through social mobilization, indigenous organizing, and ongoing public pressure.

Grassroots movements have made native seed markets into hubs of seed sharing and community resilience, but also platforms for political and cultural resistance. These events highlight the risk of GMO incursion into the food system—which activists connect to top-down agribusiness policies and gene-editing pilot projects. Notably, contamination cases have been reported in Petén and Chiquimula, heightening community alarm and scrutiny.

Despite lacking formal bans, Guatemalan civil society is actively resisting through education, farmer exchanges, and campaigns. The defense of native seeds is directly tied to indigenous cosmovision, land rights, and communal autonomy—highlighting the spiritual and relational dimensions of the GMO debate.

Indigenous cosmovision regards seeds and land as sacred, interlinking agriculture with communal life. This perspective has rallied movements that see defense of native seeds as inseparable from wider struggles over territory and autonomy.

The resistance movement explicitly contrasts its agroecology-based vision with the corporate biotech push for patented, industrialized seeds.

A historic example was the 2014 defeat of the so-called "Monsanto Law" (Decree 19-2014), which would have criminalized farmer seed sharing and paved the way for privatization. Nationwide mobilizations—including massive road blockades by indigenous and campesino communities in regions where maize has deep cultural roots—forced the law's repeal and protected traditional seed systems from expropriation.

Women, especially in Maya communities throughout Sololá, are pivotal in these struggles, maintaining local seed banks and educating the next generation in the careful stewardship of heirloom maize. At the policy level, indigenous groups have been demanding respect for free, prior, and informed consent, denouncing gene-edited maize promotion, and advocating for strong protections for biodiversity and ancestral knowledge.

In its July 2015 decision, the Guatemala Western Appeals Court referred to ILO Convention 169, which guarantees indigenous peoples the right to be consulted before mega-projects are carried out on their ancestral lands. This international convention has been a crucial legal tool for Guatemalan communities defending their territories—especially when national laws and government institutions have failed to protect their rights to land and self-determination.

Guatemala's movement demonstrates that food sovereignty here is not only about what is grown, but also about political empowerment, cultural survival, land rights, and environmental justice. Local organizations continue to build solidarity networks, sustain public resistance, and offer a living alternative to GMO-driven industrial agriculture.

## Asia – Courtrooms and CRISPR

While Asia has often been treated as a testing ground for biotech innovations, it is also a region where the politics of genetic engineering have played out with unique intensity and complexity. From the first approvals of GM cotton and papaya in China in the 1990s, to the farmer-led resistance in India and the Philippines, Asia's history with GMOs has always balanced government ambitions for productivity and food security with fierce debates around risk, sovereignty, and public trust. Regulatory approaches have often been fragmented—sometimes pro-industry and fast-tracked, as in the Philippines or Bangladesh; elsewhere, marked by widespread caution or outright moratoria, as in parts of India or local Chinese provinces. In recent years, the promise and controversy of CRISPR and gene editing has accelerated this divide. Governments have moved to ease restrictions, holding out hopes of climate resilience, disease-resistant crops, and global competitiveness, often exempting gene-edited varieties from classic GMO laws if no "foreign DNA" is present.

Yet, these moves have been met by a surge of grassroots mobilizations, court challenges, and demands for precaution, transparency, and democratic control —especially where gene-edited crops bypass public consultation and meaningful oversight. Underneath regulatory reforms lie questions of power: who defines "acceptable risk," who benefits from technological change, and how new biotechnologies may reinforce or disrupt corporate control, seed sovereignty, and the rights of farmers and consumers. Asia's CRISPR era reflects the continent's ongoing struggle—a dynamic interplay of state, industry, and people—where courtrooms and civil society increasingly shape the future of food and technology, demonstrating that technological innovation alone cannot resolve issues of equity, ecology, and cultural value.

**Philippines: Legal Struggles and Grassroots Victories**

The Philippines regulates gene-edited crops under a framework that distinguishes between traditional GMOs and new gene-editing technologies.

Since 2020, regulatory resolutions have enabled gene-edited organisms to be assessed based on whether they involve a "novel combination of genetic material," which determines whether full GMO regulation applies. Crops edited by techniques such as SDN-1 and SDN-2 that do not introduce foreign DNA may now be exempt from the strictest biosafety processes and instead be treated as conventional for regulatory purposes.

Recent updates to the Joint Department Circular (JDC) streamlined approval by shortening biosafety assessment timelines and simplifying compliance for developers, reflecting a broader international trend towards fast-tracking gene-edited plant approvals. At the same time, the Court of Appeals has reasserted the precautionary principle, blocking commercial propagation of Golden Rice and Bt Eggplant and demanding more rigorous compliance and public involvement.

The Philippines established biosafety protocols early, introducing Executive Order 430 in 1990, later updated by Department of Agriculture policies. Commercial Bt Maize cultivation began in 2002.

Initial oversight was managed by the National Committee on Biosafety, emphasizing containment and release procedures. In 2002, the DA's Administrative Order No. 8 set standards for GMO crop evaluation and field trials. Legal and grassroots challenges led to regulatory changes in 2016, resulting in the Joint Department Circular, which replaced older rules to ensure broader agency and public participation in biosafety decisions.

Resistance in the Philippines is longstanding and multifaceted, shaped by farmers' groups, scientists, Indigenous peoples, and advocacy networks. Since the 2000s, protest and direct action—especially against Bt Eggplant and Golden Rice—have succeeded in halting field trials and challenged regulatory fast-tracking.

Key milestones include legal petitions for a Writ of Kalikasan, multiple temporary bans, national marches, and the court-ordered halt to Golden Rice and Bt Eggplant commercialization. These movements consistently demand robust consultation, participatory risk assessment, and the preservation of biosafety standards in line with farmers' and Indigenous communities' constitutional rights.

The most recent legal victories, particularly the 2024 appeals court decision, set crucial new benchmarks: regulatory authorities are now required to place biosafety and public participation at the heart of GMO and gene editing governance, affirming that the precautionary principle and democratic consent are necessary for any future commercialization of gene-edited crops.

This legal triumph resonates far beyond the Philippines. In a regional and global context where GM crop approvals are often fast-tracked at the urging of multinational corporations, the court's decision to halt to Golden Rice and Bt Eggplant commercialization is a beacon for food sovereignty movements worldwide. Farmers' organizations in the Philippines now call for agroecological alternatives based on traditional seeds, ecological balance, and community nutrition, resisting industrial genetic engineering's dominance.

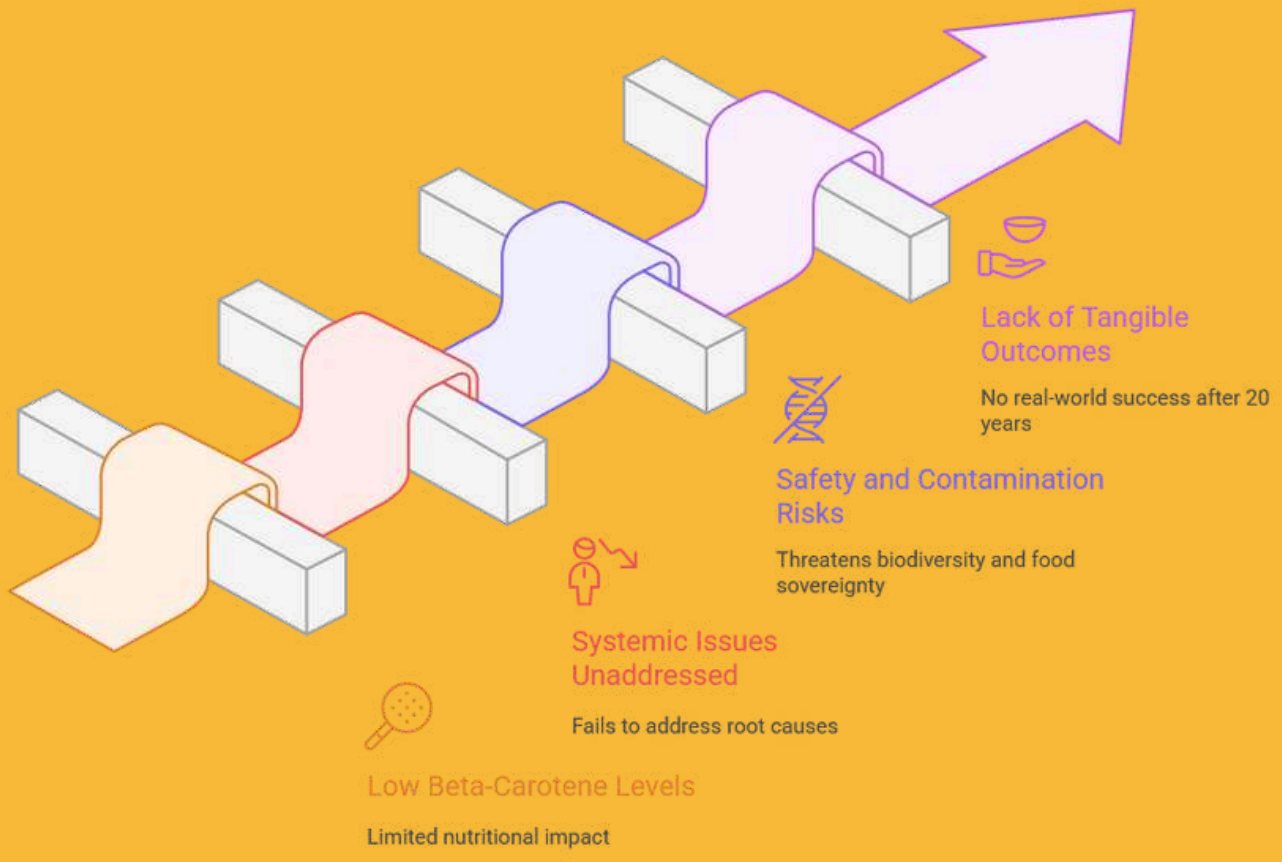
The Philippines' experience demonstrates that legal action and collective grassroots organizing can uphold the rights of farmers and communities to define their own food and agricultural futures in the face of powerful biotechnological and corporate lobbies.

## Golden Rice: Promises vs. Reality

Golden Rice belongs to the category of genetic modification strategies known as biofortification, aimed at enhancing qualitative traits of plants for consumers. First conceived in the 1980s and a focus of research since 1992, genetically engineered vitamin A rice was featured on the cover of Time magazine in 2000 as a GMO crop with the potential to save millions of lives in the Global South, proclaimed as a miracle cure for blindness. Developed to produce beta-carotene in rice, Golden Rice has since been promoted by biotech companies and their philanthropic sponsors as a silver-bullet solution to vitamin A deficiency.

Golden Rice GR2E is a first-generation genetically modified rice developed to increase vitamin A production. The traits were introduced using Agrobacterium tumefaciens-mediated plant transformation. This modification inserts three foreign genes: crt1 from Pantoea ananatis (a plant pathogen), psy1 from Zea mays, and the selection marker pmi from Escherichia coli.

In July 2021, the Philippine Department of Agriculture–Bureau of Plant Industry (DA-BPI) announced the issuance of a biosafety permit for the propagation of Golden Rice. In 2022, the U.S. Department of Agriculture and the Philippine Rice Research Institute approved its application for varietal registration under the National Seed Industry Council (NSIC). Golden Rice has also been approved for direct and indirect food use use in Australia, New Zealand, and Canada, and for food and feed in the United States and the Philippines.



The safety and effectiveness of Golden Rice remain highly debated. A 2019 study found that beta-carotene levels in Golden Rice are low and variable, providing no real solution to nutritional deficiencies. Current versions contain only 3.57 to 22 µg/g of beta-carotene, which degrade rapidly after harvest—a limitation acknowledged by the U.S. FDA.

Hunger and malnutrition are symptoms of systemic issues that cannot be addressed by a single crop. The strategy of tackling vitamin A deficiency through Golden Rice has proven ineffective in real-world contexts shaped by poor diets and food poverty. Despite more than 20 years of research and significant financial support from multinational companies, Golden Rice has not delivered tangible outcomes.

Civil society organizations and independent scientists therefore regard it as a failure, just as other GMOs developed with the promise to change our food systems for the better. Moreover, its cultivation in the Philippines raises unresolved safety concerns and the risk of genetic contamination of the country's diverse rice varieties, threatening both food sovereignty and agrobiodiversity.

In April 2024, the Philippines Court of Appeals blocked the sale of Golden Rice, along with Bt eggplant, citing violations of the precautionary principle and concerns for long-term ecological and health risks; petitioners stressed that authorities had failed to carry out proper risk assessments and ignored public participation, making this a landmark win for grassroots movements.

**Japan: CRISPR Crops enter the Market without Labels**

Japan has moved swiftly to allow the commercialization of gene-edited crops without labeling requirements. In 2024, CRISPR-engineered tomatoes designed to increase GABA (an amino acid linked to relaxation) were placed on supermarket shelves—marketed as a health food without any GMO designation.

Japan's regulatory approach draws a formal legal line between conventional GMOs and organisms altered by gene-editing techniques like CRISPR. The system claims that if no foreign DNA remains in the final product, the product should not be subject to GMO regulation; these gene-edited foods are categorically excluded from GMO biosafety assessments, traceability measures, or labeling oversight.

This deregulatory model is rooted in a 2019 Ministry of Environment clarification, which formally opened the door to streamlined, product-based approvals for a wide range of gene-edited crops, and reflects the broader trend of countries aligning biotech policy with industry demand rather than public transparency.

Consumer groups, such as the Consumer Union of Japan, and critical scientists have protested the lack of transparency, describing the move as a "silent introduction" that erases consumer choice, precludes informed consent, and prevents tracking of risks if problems arise. Environmental organizations warn that dropping robust oversight leaves gaps in the detection of possible off-target genetic effects, gene flow to wild species, and unintended ecological disruption, with potential consequences impossible to reverse if not proactively assessed.

Japan's policy not only "normalizes" gene editing domestically through stealth marketing and health rhetoric—it serves as a harbinger of a global deregulatory trend where gene-edited foods are framed as safe, natural, or indistinguishable from traditionally bred crops. This silent embrace of gene-edited crops reflects a broader global strategy to "naturalize" genetic modification, shifting regulatory frameworks away from precaution and public involvement and instead prioritizing industry innovation and speed-to-market.

As a result, the profound biosafety, ethical, and societal questions raised by these new technologies are rendered invisible to consumers, who lose both transparency and choice, while ecosystems are exposed to irreversible genetic changes in the absence of robust oversight or the precaution needed for their protection.

## Gene Editing Narratives and Safety Concerns

CRISPR/Cas technology—often referred to as "gene scissors"—is among the most influential new tools in genetic modification, within the scope of New Genomic Techniques (NGTs). Initially used across different scientific fields, it has, over the past decade, been widely applied to modify seed genomes. Through its mechanisms, CRISPR/Cas makes the genome much more accessible to modification—both with and without foreign DNA—than conventional breeding allows. Yet, this capacity for deep genomic alteration also carries substantial risk potential, creating unintended mutations that would not occur through traditional breeding.

Proponents of NGTs claim their technologies are "precise," producing only intended changes, and frequently invoke this argument to support deregulation—framing gene-edited plants as "equivalent" to conventionally bred ones. However, independent evidence paints a different picture. Reports by Test Biotech and The Greens/EFA group show that CRISPR/Cas can bypass natural repair mechanisms, change several gene loci at once, and generate new or unpredictable genotypes and phenotypes.

Far from being reliably "precise," gene editing still introduces numerous unintended alterations—both on-target and off-target—as confirmed by multiple studies on edited crops, including those on high-performance rice varieties, which showed dozens of unexpected mutations and even reduced yields. These findings are compounded by technical blind spots in standard evaluation practices. Most tests for unintended mutations focus only on short genomic segments and rely on limited methods like short-read sequencing.

In short, while new gene-editing platforms are marketed as innovative, precise, and "natural-like," scientific data continue to point to unpredictable and poorly monitored genetic and ecological consequences.

## The CRISPR GABA Tomato

The GABA-enriched tomato, developed by Sanatech Seed, is the first CRISPR-modified food ever commercialized. GABA (gamma-aminobutyric acid) is a neurotransmitter associated with relaxation and blood pressure regulation. The tomato was deregulated by the U.S. Department of Agriculture and placed on the Japanese market in 2021, sold alongside standard varieties.

Notably, this introduction occurred without any prior risk assessment for either human safety or claimed health benefits. Deregulation was justified simply because no foreign DNA had been inserted—thus, regulators deemed the alteration "similar to natural". This classification has since become a key narrative used internationally to accelerate deregulation processes.

Yet, an in-depth study by Test Biotech (2023) underscored multiple scientific gaps in this reasoning. While the CRISPR intervention successfully boosted GABA levels far beyond those seen in conventional tomatoes, researchers warned that GABA plays a complex role in plant metabolism—affecting growth, pest resistance, disease response, and metabolic pathways overall.

The report concluded: "*Due to the diverse functions of GABA in plant metabolism, one can assume that this genetic intervention influences the metabolism of tomatoes on several levels, which in turn affects nutrient composition and food quality*."

Therefore, despite industry claims of precision and natural equivalence, the GABA tomato exemplifies how deregulated gene-edited plants may differ profoundly from conventionally bred ones—posing unexamined food, ecological, and ethical questions.

**India: Gene Editing rush sparks Legal and Ethical Alarm**

In India, the deregulation of gene editing has rapidly shifted under the banner of food security and innovation. In March 2022, the Ministry of Environment exempted SDN-1 and SDN-2 (site-directed nuclease) gene-edited plants from the country's strict GMO rules if they do not involve foreign DNA. By May 2025, India's first CRISPR-edited rice varieties —DRR Rice 100 (Kamla) and Pusa DST Rice— were cleared for commercial release, essentially bypassing the biosafety protocols established for genetically engineered organisms.

These approvals, supported by the Indian Council of Agricultural Research (ICAR) and framed as climate-resilient, have drawn sharp criticism from the GM-free movements. Critics argue that the exemption and rapid regulatory approvals have bypassed meaningful public consultation and comprehensive risk assessment, and are inconsistent with India's obligations under the Cartagena Protocol on Biosafety.

Civil society voices have warned that the "relaxation" of oversight erodes transparency and participatory democracy, raising the risk of unintended ecological effects and undermining traditional seed systems. They called the decision "devious, unscientific and irresponsible," warning of strong resistance. They highlight the socio-economic dangers of deepening corporate control over seeds and farming through new technological enclosures—echoing the Green Revolution's legacy of technocratic, top-down development that marginalized small farmers and indigenous knowledge.

Despite official claims that gene editing “democratizes” innovation, India’s resistance movement continues to demand transparent, science-based evaluation and unwavering respect for farmers’ rights and seed sovereignty. The calls for agroecology and biodiversity—rather than exclusive technological fixes—reflect a vision for India’s food systems firmly rooted in social justice and the precautionary principle.

India’s vibrant agroecological movement—shaped by farmers’ collectives, seed savers, women’s networks, scientists, and grassroots organizations—has placed agrobiodiversity and seed sovereignty at the heart of the struggle for food system renewal. Across the country, communities have revived indigenous seed varieties, created hundreds of community seed banks, and championed organic and agroecological farming as responses to the erosion of agricultural biodiversity and the multiple threats posed by GMOs, seed patents, and restrictive intellectual property frameworks[6].

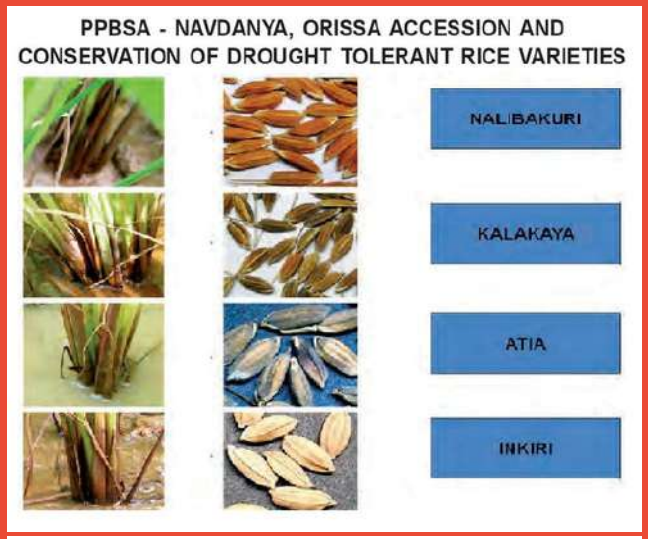
Resistance to the patenting of seeds and biopiracy has produced landmark victories, including international recognition and legal defense of crops like neem, basmati rice, and wheat[7]. Through a combination of grassroots action, legal advocacy, and ecological stewardship, India’s seed savers and food sovereignty activists demonstrate that genuine innovation means regenerating soils, sharing seeds, and empowering farming communities[8]—rather than deepening dependency on corporate-controlled technologies.

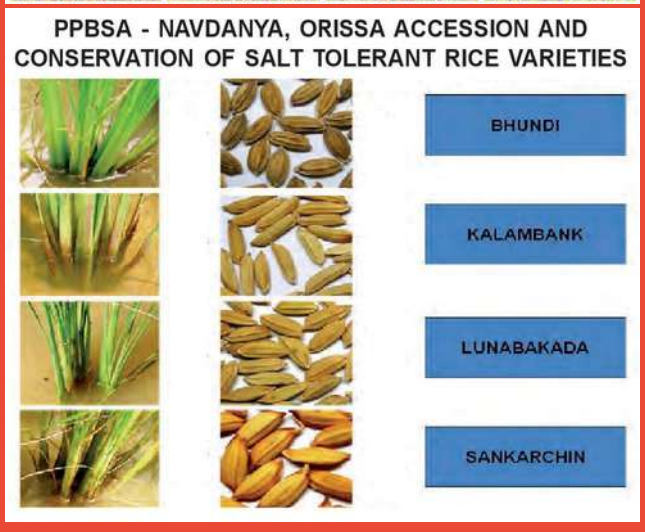
## The True Meaning of Climate-Resilient Seeds in Agroecology

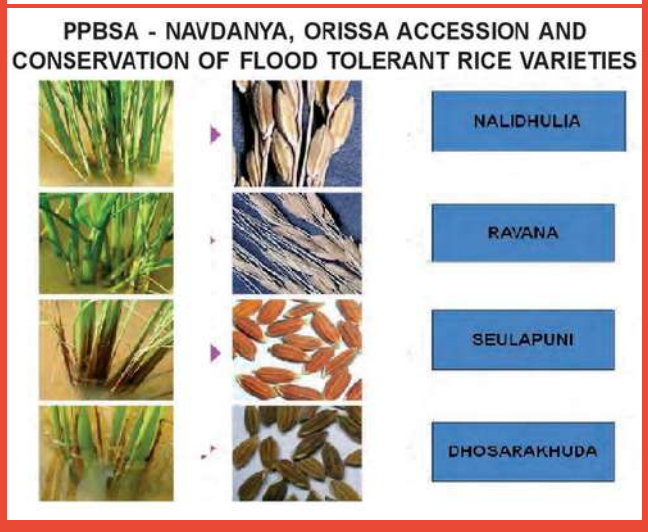
In agroecology, climate-resilient seeds are not laboratory products, but the living legacy of diverse, locally-adapted varieties shaped by nature and farmers over generations.

When seeds are bred through evolutionary, participatory selection in their specific environments—exposed to that site's cycles of drought, floods, soils, and pests—they acquire a rich constellation of genetic traits uniquely suited to thrive amid climatic uncertainty.

Such evolutionary populations, sown and selected year after year by farmers, continuously adapt to changing conditions, making the crops both resilient and deeply connected to local agroecosystems—far surpassing patented, genetically uniform seeds in adaptability and sustainability.[9]

**Bangladesh: Deregulation, Regulation, and Resistance**

Bangladesh has recently deregulated gene editing for agriculture, allowing crops developed by SDN-1 and SDN-2 techniques—provided they do not contain foreign DNA—to bypass full GMO oversight and move directly to commercial approval, following an Argentina model.

Historically, GMO regulation relied upon the Environment Policy (1992), National Biotechnology Policy (2006), and Biosafety Guidelines (2007), but the country lacked a comprehensive biosafety law and consistent enforcement.

Civil society resistance—including grassroots campaigns, legal critique, and agroecological advocacy—has repeatedly questioned both the science and governance of GMO and gene editing deregulation.

Notably, Bt Brinjal was the first genetically modified food crop commercialized in Bangladesh, but its rollout was met with persistent controversy, farmer skepticism, and organized civil society resistance.

## Bt Brinjal: Regional Adoption and Controversies

Bt Brinjal (eggplant) is the first genetically engineered food crop to reach commercial cultivation in several Asian countries. Commercial approval began in Bangladesh (2013), followed by pilot trials and contentious regulatory debates in India and the Philippines; by 2025, Bangladesh had scaled up Bt Brinjal to over 65,000 farmers, with reports of rapid expansion and mixed outcomes.

However, Bt Brinjal's rollout has been fraught with scientific controversy, farmer skepticism, and active resistance by civil society organizations. Critics have documented issues around pest resistance, yield variability, loss of traditional varieties, inadequate biosafety assessment, and gaps in farmer training.

India's regulatory authorities approved limited trials for Bt Brinjal in 2009 but imposed a moratorium after widespread protests by farmer groups, scientists, and environmental organizations. The controversy highlighted unresolved biosafety questions and the importance of public participation, eventually leading to sustained resistance against transgenic brinjal and other GM food crops.

In the Philippines, Bt Brinjal has faced similar opposition. Pilot field trials were halted by court order following advocacy from farmer-scientist alliances such as MASIPAG, which raised concerns about environmental risks, food safety, and inadequate regulatory review. The Asia-wide debate over Bt Brinjal has thus centered on biosafety, seed sovereignty, and farmer experience across multiple Asian countries.

## Africa and the GMO Drive: A New Form of Food Colonialism

Africa stands today at the crossroads of industrial agriculture and food sovereignty. The continent has become a primary target for powerful agribusiness interests, global philanthropists, and Western governments eager to promote genetically modified crops as a quick fix for hunger and climate instability.

Under the banners of "climate-smart agriculture" and "innovation," policies and investments by actors such as the Bill & Melinda Gates Foundation and the Alliance for a Green Revolution in Africa (AGRA) have flooded African agriculture with patented seeds, chemical inputs, and foreign-controlled technologies—all promising higher yields and food security. Yet after two decades and close to a billion dollars invested, the lived reality for small-scale farmers tells a starkly different story.

Rather than ending hunger, these interventions have deepened dependency on corporate supply chains and eroded the foundations of indigenous seed systems. Local and traditional varieties have been sidelined in favor of monocultures of maize, soybean, and cotton—crops controlled by international seed and chemical giants. As more countries are pressured to lift bans and open their fields to GMOs, African farmers increasingly face legal, economic, and ecological barriers: strong intellectual property rights make replanting harvested seed a risk of debt or litigation, and food production is exposed to unpredictable price shocks and climatic threats.

At the same time, evidence continues to mount that the promises of increased productivity and food security have not materialized. Independent assessments reveal that, in AGRA's focus countries, the number of people suffering extreme hunger has in fact increased—while biodiversity, soil fertility, and farmer autonomy decline. The spread of GMOs further accelerates pesticide use, damages soil health, and eliminates the genetic diversity which underpins resilience to climate crises.

In recent years, the push for rapid adoption of new gene editing technologies—framed as "innovation" or "precision breeding"—has accelerated across Africa. Backed by major industry lobbying and donor funding, regulatory frameworks are being rewritten in countries like Nigeria and Kenya to exempt many gene-edited crops from GMO oversight, arguing that such plants are "indistinguishable" from those bred conventionally. This shift is justified by promising faster, cheaper solutions to climate and pest pressures—yet it is happening with minimal public debate or transparent risk assessment, often bypassing biosafety standards and side-stepping the need for traceability or labeling.

International partnerships and public-private consortia are investing heavily in genome-edited sorghum, millet, and other staples, granting multinational firms and select biotech start-ups privileged access to local seed markets and research infrastructure.

For civil society and farmer-led movements, this rapid deregulation represents a new “biotechnological enclosure” of Africa’s seed commons—where decisions about food and farming are made by external actors, eroding sovereignty and exposing agroecosystems to untested risks, all in the name of modernity and market access.

Civil society networks, farmers’ movements, and environmental defenders across Africa are calling for a paradigm shift: one that recognizes the dangers of external “solutions,” recenters agroecology, and refuses to accept a future where Africa is once again a laboratory for foreign interests at the expense of local communities and ecosystems.

True sovereignty and climate resilience can only grow from the fertile ground of seed freedom, traditional knowledge, and the rights of farmers to save, exchange, and plant diverse native seeds.

**Nigeria: The Contested Frontier of GMO and Gene Editing Regulation**

Nigeria established the National Biosafety Management Agency (NBMA) in 2015 to regulate GMOs and emerging genetic technologies. The NBMA's mandate covers risk assessment, permitting, and monitoring for genetically modified organisms, including crops, animals, and microorganisms.

In 2020, Nigeria released its National Guidelines for the Regulation of Gene Editing, which set procedures for case-by-case evaluation: gene-edited products without recombinant DNA or novel genetic combinations may be exempt from full GMO regulation, requiring only NBMA clearance. However, products involving foreign DNA remain subject to strict biosafety protocols. This puts Nigeria among those adopting an "Argentina model" of product-based regulation, but ongoing debates question the adequacy of risk analysis and public oversight.

Nigeria's journey with GMOs began in the early 2000s, signing a major agreement with the US to promote biotech crops. The critical milestone was the Biosafety Management Act of 2015, which formalized risk assessment and permitted commercial GMO import, distribution, and cultivation. Crops like Bt cotton, Bt cowpea, TELA maize, and GM soya have received approval for commercial release.

Critics argue the regulatory process has focused on developer-submitted data, with limited independent assessment and questionable public consultation.

Nigeria is home to persistent and dynamic resistance against the spread and deregulation of GMOs. Civil society networks, such as Health of Mother Earth Foundation, ERA, food sovereignty advocates, and farmer groups have challenged both the science and politics of GM crop approval and gene-editing deregulation.

Leading activist Nnimmo Bassey has argued for ecological farming and indigenous knowledge as safeguards against hunger, as well as for genuine public participation in biosafety debates. Nigerian activists warn that the biosafety law amendments and new gene editing guidelines risk opening the country to poorly regulated, corporate-led biotech expansion. Recent policy proposals have triggered strong reactions, with civil society calling for a precautionary approach, rigorous risk assessment, and a moratorium on commercial GMO and gene-edited crop release.

These ongoing debates, campaigns, and demonstrations highlight grassroots demands for transparency, ecological farming, and respect for indigenous and community rights in shaping Nigeria's agricultural future. As the biosafety regime continues to evolve, civil society remains vigilant, advocating for robust safeguards and the defense of food sovereignty in the face of rapid gene editing and GMO deregulation.

**South Africa: From Pioneer to Precaution in GMO Governance**

South Africa is the largest adopter of GMOs on the African continent, with over 3 million hectares of genetically modified crops under cultivation. Three GM crops dominate commercial cultivation: maize, soybean, and cotton. Maize accounts for over 85% of the crop area planted with genetically modified varieties, while approximately 95% of soybean and nearly 100% of cotton production rely on GM seeds. These modifications primarily confer herbicide tolerance and insect resistance, highlighting the central role GM crops play in the country's agricultural system.

While in 2019 the Minister of Agriculture, Thoko Didiza, rejected Monsanto's application for cultivation of GM maize seed MON87460 x MON89034 x NK603, a shift occurred in August 2022, when the South African government approved the importation of GM wheat variety HB4 for use in food, feed, and industrial processing. The approval was granted under the GMO Act, with the authorities claiming sufficient scientific evidence to conclude the wheat was safe for human and animal consumption.

Civil society organizations strongly opposed this decision. In 2023, a submission endorsed by more than 80 organizations called for a review of the HB4 wheat approval, arguing that the risk assessment lacked essential food safety evidence, including feeding studies, and that the wheat posed risks to health, food sovereignty, and nutrition security.

In 2024, objections were filed against field trials of Trigall HB4 wheat, continuing a longstanding history of resistance to GM wheat in the country. In the same year, South Africa updated its regulatory framework: under the GMO Act, all new breeding techniques (NBTs) and live products became subject to the same risk assessment procedures as transgenic GMOs.

In October 2024, South Africa's Supreme Court of Appeal (SCA) set aside the commercial approval of Monsanto/Bayer's drought-tolerant GM maize MON87460, following nine years of litigation. The court found that the Executive Council had failed to determine whether an environmental impact assessment was required under the National Environmental Management Act. Importantly, the SCA confirmed the centrality of the precautionary principle in GMO decision-making, overturning earlier rulings that had dismissed its relevance.

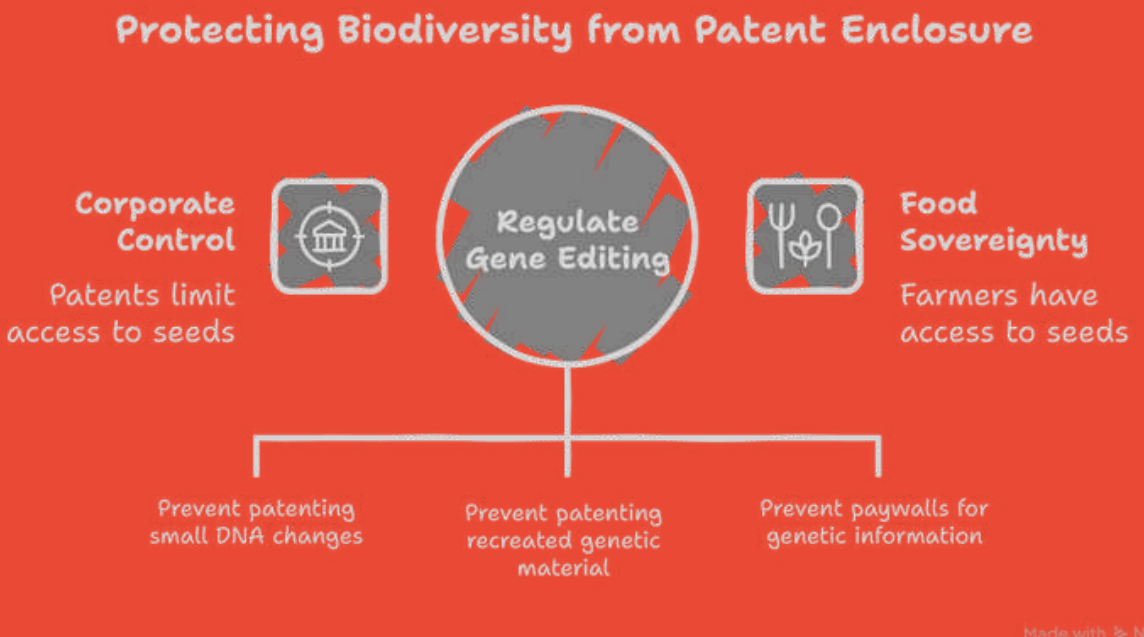
Most recently, objections to field trials of GM canola were submitted, pointing to ongoing biosafety concerns

## Biopiracy by Patent—Gene Editing's New Enclosures

Modifications through NGTs—particularly CRISPR—are presented as fundamentally different from GMOs, with the result that crops are often classified as "non-GMO" if no foreign DNA is added. Yet this distinction is misleading. Not only can CRISPR be used to insert foreign DNA, but even when it does not, it bypasses natural repair mechanisms and introduces genomic changes that no conventional breeding could achieve. Most notably, patenting undermines the "natural-like" narrative. Natural plants and traits cannot be privatized. Either these organisms are artificial enough to qualify as private inventions, or they are genuinely "natural" and therefore outside the scope of patents.

NGT products and the deregulation of gene editing have fueled an explosion of patents on genetic traits, dramatically increasing corporate control over seeds and biodiversity. Agribusiness giants like Corteva, Bayer-Monsanto, BASF, and Syngenta now hold hundreds of patents on methods, traits, and whole genetic sequences derived from gene editing, with Corteva now the largest CRISPR license holder in agriculture. Unlike earlier GMO patents, gene editing enables companies to patent even small DNA changes—including "technical topping" edits to natural gene variants—as well as seeds, plants, and derivatives that follow.

Companies sometimes use gene editing as a pretext for new patents: by making minimal changes to older, previously unpatentable GMOs or to non-GM plants, they can close off access to genetic resources that were once part of the commons. Others even patent naturally occurring gene variants in crops like wild soybean relatives, arguing only that gene editing "could" be used to access them.



Digital Sequence Information (DSI) accelerates this enclosure: companies can scan, upload, and recreate genetic material from public databases, then claim patents on the resulting sequences in the lab—often circumventing both existing biodiversity regulations and the spirit of the Nagoya Protocol. Even public gene banks and global seed collections face risks of appropriation as digitalized DNA becomes a new raw material for private biotechnology.

Adding to this, corporations are establishing licensing platforms—effectively paywalls for genetics—putting further barriers between small breeders or farmers and the seed material they need. Such platforms enable extraction of royalties and allow companies to dictate the use of patented information, even to national breeding programs.

In sum, biopiracy through patents is being taken to unprecedented levels by gene editing and DSI, threatening not just farmers' rights, but the genetic foundations of food sovereignty worldwide.

Meanwhile, international governance is struggling to keep pace with these new enclosures. In October 2025, negotiations under the FAO International Treaty on Plant Genetic Resources (ITPGRFA) intensified around the Multilateral System (MLS) and its Standard Material Transfer Agreement (SMTA).

Proposals for reform include mandatory benefit-sharing payments for the use of DSI, subscription-based access models for seed collections, and stricter patent transparency obligations. Yet, consensus remains elusive: several industrialized nations reject binding payments and strict rules on DSI-derived patents, while civil society warns that persistent loopholes may allow biopiracy to continue through minimal sequence tweaks or proprietary digital data.

As highlighted in October 2025 treaty negotiations and civil society presentations, ongoing enclosure risks, lack of enforcement, and disputes about the commons status of gene bank holdings remain serious concerns. Unless international rules are strengthened and applied with full transparency and accountability, gene editing and DSI-facilitated patents are set to further extend private control over crop diversity, challenging both farmer sovereignty and the public domain.

## Oceania From Precaution to Deregulation

For decades, the continent of Oceania—particularly Australia and New Zealand—stood as an international reference point for precaution in GMO governance, built on early moratoria and strict laws responding to ecological vulnerability, public skepticism, and the legacy of Indigenous rights protections such as Te Tiriti o Waitangi.

Regulatory systems were built on robust biosafety and community consultation, resisting rapid market entry of new genetically modified organisms and prioritizing environmental due diligence.

However, the last decade has seen a sharp recalibration, driven by political narratives invoking "innovation," climate resilience, and economic competitiveness. Governments—under increasing pressure from agritech and biotech industries—have reoriented policy, privileging speed-to-market and the deregulation of gene-edited and biofortified crops, especially those created with new genomic techniques such as CRISPR.

Amendments like Australia's 2019 Gene Technology Regulations and New Zealand's Gene Technology Bill have eliminated oversight for certain gene-edited organisms and narrowed public input.

This shift is not rooted in scientific consensus around safety, but in the alignment of regulatory practices with global trade interests, competitive agricultural export strategies, and the promise of biotech "solutions" to complex crises—from biofortification (e.g., Vitamin A bananas) to climate-adaptive ryegrass.

Civil society and Indigenous advocacy networks continue to warn that the deregulatory approach threatens ecological integrity, transparency, and community participation, placing the foundational principles of precaution at risk under a new commercial imperative.

Together, these developments mark Oceania's transformation from a bastion of caution and participatory science to a frontline in global deregulation, shaped less by ecological wisdom and more by the political and economic ambitions now guiding the future of gene editing and biofortification in agriculture.

**New Zealand: From Caution to Commercialization**

New Zealand has long been recognized internationally for its precautionary stance on genetic engineering, rooted in the country's commitment to biodiversity protection, indigenous rights under Te Tiriti o Waitangi (Treaty of Waitangi), and public engagement.

However, in August 2024, the government introduced the Gene Technology Bill 2024, marking a significant shift from its historically cautious regulatory framework. This legislation aims to enable gene-edited organisms to be developed outside of lab settings, facilitating the commercial use of new genetic technologies.

The most controversial case is the pending deregulation of CRISPR-engineered ryegrass, developed by AgResearch to modify fungal endophytes that reduce methane emissions and improve livestock performance. This gene-edited perennial ryegrass has been promoted by the government as a climate-smart solution.

The proposed shift continues to draw strong opposition from civil society groups—including GE-Free New Zealand and Māori advocacy organizations—who warn of uncontainable gene flow, inadequate risk assessment, and potential violations of indigenous rights under Te Tiriti o Waitangi.

Concerns persist about uncontrolled dispersal of gene-edited organisms, threats to native flora and ecosystems, and ongoing gaps in long-term monitoring and Treaty obligations.

Major developments in October 2025 have further complicated the legislative pathway, as the Health Select Committee published its report on the Gene Technology Bill, recommending the bill proceed.

However, this is not the final step: the recommendation is non-binding and the bill must now pass its second reading in Parliament. Amid this process, New Zealand First announced it would withhold support unless major changes are made, raising doubts about the government's ability to secure a majority. Science Minister Judith Collins has publicly stated that the fate of the bill remains uncertain, with further debate and possible amendments expected.

Meanwhile, environmental groups continue to highlight what they consider inadequate protections for New Zealand's GE-free status and risk to the country's international market reputation.

**Australia: Deregulating Gene Editing, Sidestepping Precaution**

Australia is in the midst of a major policy shift that is transforming its approach to genetic engineering and gene editing in agriculture.

For two decades, the Gene Technology Act 2000 and corresponding state and territory laws strictly regulated genetically modified organisms (GMOs), requiring comprehensive risk assessment, licensing, and community consultation before the release of any GMOs into the environment.

However, starting in 2019 and accelerating in recent years, the federal government has pursued sweeping deregulation of gene-edited organisms.

Under amendments to the Gene Technology Regulations 2001, gene-edited plants and animals produced using site-directed nuclease 1 (SDN-1) techniques —such as CRISPR/Cas9, provided they do not involve foreign DNA—are now excluded from GMO regulation altogether. This means such organisms can be developed, grown, and marketed without notification, risk assessment, or public consultation.

These changes place Australia at the forefront of global gene editing deregulation, aligning with the most industry-friendly policies seen in countries like the USA, Brazil, and Argentina.

Food Standards Australia New Zealand (FSANZ) is simultaneously proposing to redefine GM food in a way that would exempt most gene-edited food and animal products from pre-market safety assessment, traceability, or labelling requirements. This could mean gene-edited foods entering the marketplace with no transparency and effectively removing the public's right to know what they are eating.

Peak food sovereignty and organics groups and the organic industry—are strongly opposed to these changes.

They warn that deregulation creates a "free-for-all," threatens organic export status, and shifts the burden and cost of identity preservation onto non-GM supply chains, especially those seeking certification for organic or GM-free status.

They argue that the government's deregulatory approach prioritizes speed-to-market and industry innovation at the expense of precaution, transparency, and public engagement—raising the risk of unintended environmental impacts, cross-contamination, and a collapse of consumer choice.

Analysts and independent scientists have pointed out that these deregulations risk sidelining democratic consultation and undermining environmental protection. They underscore that regulatory decisions should be science-based, transparent, and involve broad community dialogue—not simply reflect industry lobbying or economic expediency.

Bioethical and food policy advocates also note that these changes may jeopardize Australia's high-value organic and export markets, given that key trading partners (including Europe and China) still recognize gene-edited crops as GMOs and require strict traceability.

Australia's evolving approach to gene editing exposes a deep conflict between the drive for technological innovation in agriculture and the principles of public participation, biosafety, and food sovereignty.

As the country removes barriers for gene-edited crops and animals, it risks not only eroding hard-won rights for consumers and farmers—but also undermining its environmental integrity and international standing as a supplier of clean, traceable, and trustworthy food.

## Environmental risks: Gene flow, cross contamination and erosion of biodiversity

Beyond potential impacts on consumers, a common concern with GMOs worldwide relates to environmental risks. While often dismissed as minimal by developers, these risks pose threats to biodiversity, agrobiodiversity, and the stability of ecosystems. As of now, there is no reliable system to control environmental and biosafety issues regarding field testing or cultivation of genetically modified species. Unintended gene flow threatens the local biodiversity in terms of contamination of wild species with engineered traits such as tolerance to herbicides, which in turn has effects on the ecosystem: the development of, for instance, pollinator insects are affected by unintended, but highly possible, risk of widespread.

Documented cases of contamination of wild species include Beta vulgaris, Avena strigosa, and Brassica napus. Studies have reported impacts on all stages of the ecosystem, as well as broader biodiversity loss and gene instability.

In transgenic cotton, the insecticidal Bt trait has raised concerns due to its harmful effects on various insect larvae, potentially disrupting local food webs and ecosystem balance. In Mexico, the situation is further complicated by the unchecked spread of genetically engineered cotton varieties. These transgenes —including those for herbicide tolerance and insect resistance—have entered wild Gossypium hirsutum populations. As a result, researchers have observed changes in nectar production, which alter relationships with ant species that are important for pest control and seed dispersal. Such changes could have cascading ecological effects. There is also concern that enhanced nectar production may confer invasive properties to Bt cotton descendants, threatening the genetic integrity and biodiversity of wild cotton.

Further examples include Bt maize traits found in milkweed leaves which in turn proved toxic to monarch butterfly larvae. Other studies found delayed development and altered maturity in insect species such as Ostrinia nubilalis and Spodoptera littoralis feeding on Bt maize leaves expressing Cry1A toxins.

Beyond the emergence of several dozen glyphosate-resistant weeds worldwide, genetically engineered plants themselves can also develop weedy characteristics. Herbicide-resistant GM plants that spread in the environment may interbreed and acquire resistance to multiple herbicides. These multiple resistances are thought to have arisen through hybridisation of different single events and subsequently spread into wild cotton populations. Comparable cases have been documented in genetically engineered canola in Japan and the United States.

Cross-contamination of wheat has already been documented in several instances worldwide, even from field trials alone. In two out of three recorded cases, regulators were unable to identify the source of escape, which demonstrates that contamination pathways are not always clear and cannot be dismissed as unlikely. For instance, one of the cases occurred between eight and fifteen years after the original trial had taken place, and was detected by chance.

Gene driven technology or gene drive organisms (GDOs), enabled by CRISPR/Cas9, is designed to genetically modify, replace, or eradicate wild populations by forcing engineered traits to spread through inheritance. Potential applications include agriculture, conservation, medicine, and military use, with current research targeting insects, plants, and other organisms. Unlike other genetic engineering methods, gene drive organisms are meant to spread uncontrollably through ecosystems, creating irreversible genetic changes. This raises severe risks for biodiversity, ecosystem stability, food security, and human health, with impacts that remain unpredictable and insufficiently understood. Conservationists warn against promoting gene drives as a tool for biodiversity protection, given the absence of reliable methodologies for risk assessment and the potential for catastrophic, irreversible effects.

Although still new and unproven, gene drives have already provoked significant concern among ecologists, biosafety experts, and civil society, many of whom support a call for a moratorium on the technology. By deliberately using engineered genes to alter entire populations, gene drives reverse the usual imperative of containing genetic modifications to prevent ecological disruption. The underlying technology is unpredictable and may trigger unintended spread of traits. The assumption that a species can be removed from an ecosystem without negative consequences for food webs and ecological functions is unfounded; even eliminating a parasite's carrier does not ensure the parasite will not shift to another host. The capacity to re-model or erase species at the genetic level has also drawn the interest of militaries and agribusiness, raising further concerns.

Lastly, the increased use of herbicides and pesticides associated with resistant GMO crops directly erodes biodiversity. It contributes to processes such as desertification and has long-lasting detrimental effects on ecosystems, as illustrated by the sharp decline of bee populations all over the world. Such impacts pose serious risks to the long-term stability of food systems.

## Europe: Crossroads in GMO Regulation amid Gene-Editing Deregulation Push

The deregulation of gene editing in the United Kingdom, accelerated after Brexit, has served as a forerunner to the debates now unfolding in the European Union. By abandoning the precautionary principle and creating a new legal category of “precision bred” organisms, England anticipated many of the arguments and deregulatory strategies that are now shaping the EU’s legislative discussions.

The European Union, once a global stronghold of the precautionary principle in GMO regulation, is now at a pivotal crossroads. In July 2023, the European Commission proposed a legal reform that would exempt many gene-edited organisms from the EU’s strict GMO legislation, specifically targeting "new genomic techniques" (NGTs). Under the proposal, gene-edited crops without foreign DNA would no longer be subject to risk assessments, labeling, or traceability obligations—effectively making them indistinguishable from conventional crops in the eyes of consumers and regulators.

This deregulatory shift would equate certain gene-edited crops with products of conventional breeding in the regulatory framework, removing key safeguards that inform both consumer choice and ecological risk management. The biotech industry, with substantial lobbying, has championed these changes, arguing they will enhance innovation and streamline market approval.

However, the proposal has provoked widespread backlash from environmental NGOs, organic farmer alliances, seed sovereignty defenders, and civil society networks across Europe.

While this rollback garnered the support of the biotech industry, environmental organizations, farmer alliances, and civil society across the EU have denounced the proposal as a dangerous rollback that undermines both consumer rights and seed sovereignty. Hence, civil society in Europe has erupted in protest.

On 11 February 2025, over 200 organizations—including Greenpeace, La Via Campesina Europe, IFOAM Organics Europe, Pollinis and others—published a "Joint Statement on the deregulation of New GMOs," demanding that European governments uphold the precautionary principle, maintain transparent labeling and traceability, and defend robust risk assessment processes—foundations of Europe's current food sovereignty, consumer information, and ecological protection.

Deregulation threatens small breeders, organic farmers, and seed sovereignty, exposing them to biopiracy, patent lawsuits, and irreversible consolidation of the seed market. A follow-up declaration by organic stakeholders reinforced that quality agriculture cannot thrive by "mistreating ecosystems."

Notably, on 8 April 2025, more than 115 organizations—including CIDSE, Friends of the Earth Europe, Via Campesina, IFOAM Organics Europe, FIAN, ARC2020, Slow Food, and many others—issued a high-profile open letter demanding full

transparency, mandatory labeling, and rigorous risk assessment for all new GMOs, including those produced with gene editing. This coalition emphasized that dismantling existing regulations exposes European food production to hidden risks, strips consumers of their right to informed choice, and facilitates unchecked corporate concentration in the seed sector.

Specifically, critics warn this policy would enable biopiracy and legal threats against small breeders, farmers, and organic producers, accelerate market concentration in corporate hands, and undermine the ability of growers to maintain GMO-free and biodiverse production systems. IFOAM Organics Europe and other organic leaders highlighted that "quality agriculture cannot be built by mistreating ecosystems" and that only genuine ecological approaches will guarantee resilient, sustainable farming.

Echoing this position, a growing chorus of mobilizations since 2022 has brought together organic, environmental, and social justice groups across dozens of countries—organizing public demonstrations, advocacy campaigns, and direct appeals to policymakers to safeguard the EU's precautionary approach and uphold food democracy. These alliances have declared that true innovation in European agriculture means protecting agrobiodiversity, seed sovereignty, the rights of farmers and eaters, as well as robust public oversight over powerful biotech interests.

Across the European Union, this groundswell of coordinated protest has been matched—and often amplified—by dynamic national mobilizations. In response to both EU-level legislative proposals and their national repercussions, movements in countries such as France, Germany, Italy, and beyond have taken to the streets, engaged policymakers, and launched targeted campaigns to defend food sovereignty, seed autonomy, transparent labeling, and the rights of farmers and consumers. The following country snapshots illustrate how, behind the headlines, grassroots alliances and civic resistance continue to shape the trajectory of GMO and gene-edited crop regulation at the national level—demonstrating that the struggle for precaution and democratic oversight is as local as it is continental.

**United Kingdom: Gene Editing Deregulation and the End of Precaution**

The United Kingdom, and particularly England since Brexit, has rapidly become a global testing ground for the deregulation of gene editing in agriculture and food systems. Where EU law once enforced strict regulations and the precautionary principle, the UK government has pivoted toward a policy framework that places scientific innovation and industry partnership at its core—removing many established safeguards surrounding gene-edited organisms.

In March 2023, the UK government passed the Genetic Technology (Precision Breeding) Act, establishing a new regulatory pathway for so-called "precision bred" organisms—those created using gene editing without introducing foreign DNA. This distinction allowed gene-edited crops to sidestep earlier rules for GMOs, quickly followed by the signing of the Genetic Technology (Precision Breeding) Regulations in May 2025. These regulations will enable gene-edited crops to be commercially grown and marketed in England, marking a formal operational shift away from requiring detailed risk assessment, consumer labelling, or traceability for these products—which by law are considered distinct from GMOs if their changes "could have arisen naturally or through traditional breeding".

Government and industry proponents have celebrated this deregulation, arguing that it will invigorate agri-food innovation, enhance climate resilience, and improve national competitiveness. They maintain that gene editing is a safer, faster, and more precise technique compared to older, transgenic GMOs, and that such changes are no less “natural” than traditional breeding.

However, these arguments have met with determined criticism from UK-based food and environmental justice organizations, along with a range of food sovereignty advocates and scientists. Civil society groups warn that removing or diluting risk assessment, transparency, and labelling not only erodes consumer choice but could allow gene-edited crops and foods to enter supply chains without sufficient oversight or independent scrutiny. While the government claims that gene-edited plants with “naturally arising” changes pose no more risk than conventional crops, research highlighted by critics points out that gene editing can create unexpected or unintended genetic effects and that, once released, these organisms could irreversibly transform farming systems and ecosystems.

Furthermore, critics note that the rapid adoption of gene editing policy in England took place with limited public debate or stakeholder engagement, essentially sidelining popular consultation and failing to address animal welfare, biodiversity, and wider ethical concerns. It is also notable that while England is spearheading this deregulatory approach, Scotland, Wales, and Northern Ireland have chosen to retain regulatory alignments closer to the European Union, reflecting continued divisions over societal oversight and regional food integrity.

Commercialization is already underway, with the UK government touting trials for gene-edited wheat, camelina, and other crops—heralded for their promised climate benefits and agronomic efficiencies, but still subject to intense public interest and opposition. The contrast with EU policy—where the future regulatory status of gene editing remains fiercely debated—is striking, and the implications for cross-border trade, seed sovereignty, and environmental protection are profound.

The UK now finds itself at the forefront of a wider global shift: away from caution, public engagement, and rights-based food and seed systems, towards a policy landscape that privileges rapid commercialization and industry alignment. For movements defending food sovereignty, biodiversity, and consumer transparency this trajectory is both a cautionary tale and a rallying point for renewed vigilance and ethical debate.

**France - Mobilizations against EU Legislation Draft**

Thirteen French organizations recently alerted President Macron and Prime Minister Borne that the draft EU legislation would remove core safeguards such as labeling, traceability, and even the right for countries to restrict GMOs —warning that, “the deregulation… risks making the French agricultural model less autonomous… endangering GMO-free agriculture and all agricultural alternatives based on principles that respect biodiversity”.

Nationally, this deregulatory proposal has also met with strong grassroots opposition. In January 2024, farmers and local activists in Occitania (Toulouse and Carcassonne) launched roadblocks and targeted infrastructure in protest against the liberalization of new genomic techniques (NGTs). Initial mobilizations began on January 16, followed by symbolic blockades on the Tarbes highway on January 18. On the night of January 18–19, an explosion damaged a building belonging to the regional environmental agency DREAL in Carcassonne, in an action claimed by the Comité Régional d’Action Viticole (CAV), a group historically critical of agricultural biotechnologies. Protesters feared that the new EU rules would make it impossible to distinguish new GMOs from conventional products, threatening the future of organic farming, traceability, and food sovereignty.

**Germany - Farmers Protests against Deregulatory Push**

Germany has been a key battleground for the EU’s legislative debate on gene editing and GMO deregulation. The German government, bolstered by consistent opposition from the Green Party and many Social Democrats, has maintained a cautious stance and advocated for strict regulation.

Between December 2023 and February 2024, Germany saw widespread farmer protests, with tractor blockades and demonstrations in Berlin and cities across the country. While initially focused on subsidy cuts and agricultural taxes, many protests included opposition to the EU’s deregulatory push for new genomic techniques (NGTs) among their key concerns. Farmers and their unions have repeatedly called for binding criteria on origin labeling and demanded that GMOs and gene-edited crops remain strictly regulated to protect traditional, organic, and regional farming systems.

This convergence of grassroots mobilization and institutional advocacy underscores strong resistance in Germany—both from civil society and the farming sector—to weakening safety, labeling and traceability standards for gene-edited organisms in food and agriculture.

**Italy: A Frontline of Legal and Territorial Resistance**

Italy has become a key EU battleground over gene-editing deregulation.

In April 2024, the Italian government adopted a decree aligning national policy with pending EU reforms, allowing field trials and commercial release of gene-edited crops without standard GMO safeguards.

This move triggered an immediate formal challenge from a civil society alliance, arguing that gene-edited crops remain GMOs under the law and must undergo full risk assessment, traceability, and labeling. This advocacy action succeeded in suspending the implementation of the government's decree, effectively halting its progress and placing Italy at the heart of Europe's regulatory controversy.

On the ground, municipalities and regions are declaring themselves GMO-free—including for gene-edited crops—to assert local rights over seeds, biodiversity, and food systems. The national "GMO-Free Municipalities" campaign strengthens territorial resistance to both transgenic and gene-edited crops.

In response to the 2025 EU deregulation proposals, Italian and European civil society organizations issued a comprehensive position paper warning that deregulation risks expanding corporate seed patents, fostering biopiracy, and eroding farmers' rights. Their demands include mandatory traceability, labeling, closure of patent loopholes, and investment in agroecological alternatives—defending food democracy and the precautionary principle in a shifting EU landscape.

This mobilization reached a high point in June 2025, when movements gathered in Parma—home to the European Food Safety Authority (EFSA)—for a major national demonstration. The protest denounced the EU deregulation push, reaffirming a strong "no" to new GMOs, the defense of agroecological, farmer-led agriculture, and the rejection of seed privatization and loss of food sovereignty.

The ongoing debate reflects deeper fault lines in European policy—between accelerating technological innovation for market and biotech sector demands, and maintaining environmental, societal, and democratic standards of transparency, precaution, and farmer/consumer rights. Civil society has made clear that these regulatory reforms pose major risks to transparency, consumer choice, farmers' sovereignty, and the long-standing European commitment to agricultural sustainability.

As the EU navigates this contentious and closely watched process, the outcome will determine whether Europe holds firm to its historic legacy of precaution and democratic food policy—or embraces a deregulatory path with potentially irreversible impacts on biodiversity, agriculture, and social equity.

## Sovereignty, Culture, and the Seeds of the Future

Behind the court cases, regulatory reforms, and political battles lies a deeper truth: the global struggle over genetically modified organisms is not merely about science or trade—it is about who defines life, who controls the future, and what kind of world we are cultivating.

Across Latin America, Africa, Asia, Oceania and Europe, communities are not only rejecting genetic engineering—they are cultivating radically different visions for agriculture, rooted in reciprocity, memory, and interdependence. These movements see seeds not as proprietary inputs but as living ancestors, as repositories of culture and cosmology, as kin to be respected rather than modified.

Seeds are the result of millennia of farmers' breeding, beginning with the domestication of wild plants and evolving through generations of careful observation, selection, and knowledge-sharing. Most of the staple crops that feed the world today—wheat, rice, maize, and potatoes—are the legacy of indigenous peoples who developed diverse, resilient varieties through collaborative adaptation and mutual care.

In Mexico, the defense of maize is a defense of an entire cosmovision. In Guatemala and Peru, seed fairs are not simply economic exchanges—they are ceremonies of remembrance and ecological care. In the Philippines and Italy, legal victories are accompanied by communal organizing, education, and a deep sense of relational responsibility to land and life.

This is the soil in which true sovereignty is growing. Not the sovereignty of borders or governments alone, but the sovereignty of place-based communities to define their own food systems, to protect the integrity of their ecosystems, and to pass on ancestral knowledge to future generations.

This profound relationship with seeds is rooted in a worldview of learning from nature's diversity, supporting mutuality and collaboration, and stewarding seeds as a commons—a source to be conserved and shared for collective well-being. At its heart, the pushback against GMOs and gene-editing is a refusal to allow life to be reduced to code and profit, a refusal to be severed from the relational intelligence that has sustained cultures for millennia.

The wisdom of traditional breeding is fundamentally collaborative: farmers have saved seeds from the most resilient plants, traded varieties across communities, and sustained thousands of locally adapted crops capable of weathering environmental and climate challenges.

Today, over 95 percent of seeds used globally remain linked to these traditional, local systems—even as patented seeds shape policy and funding priorities.

Navdanya International continues to emphasize, the way forward lies in Making Peace with the Earth—not through domination or technological conquest, but through diversification, intergenerational responsibility, and economies of care. It lies in acknowledging that true innovation does not emerge from synthetic genes, but from the creative intelligence of life itself—woven through forests, fields, fungi, and farmers.

In the face of global deregulation and the erasure of legal protections, these movements offer not only resistance but profound alternatives. They are not just saying no to GMOs—they are saying yes to a future of ecological democracy, seed freedom, and the sacredness of life.

All around the world, these alternatives are not theoretical—they are thriving realities. Biodiversity-based agroecology, organic farming, and community-managed seed systems continue to regenerate soils, foster climate resilience, and secure food sovereignty in diverse contexts. Farms that rely on traditional seeds and diversified cropping consistently weather environmental shocks, supporting stable yields, pollination, and nutrient cycles, while empowering communities to recover quickly after disasters.

At their core, these models embody an ethic of care, knowledge sharing, and stewardship of the commons—values that restore balance and abundance for farmers, ecosystems, and future generations.

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[5] **Salvatore Ceccarelli** was associate professor of Genetic Resources and later full professor of Applied Genetics at the University of Perugia until 1987. From 1980 to 2011, he worked at ICARDA in Syria, pioneering participatory plant breeding to boost yields, biodiversity, and climate resilience in countries such as Syria, Jordan, Algeria, Ethiopia, Eritrea, Yemen, and Iran. More recently, he has promoted evolutionary plant breeding to return seed control to farmers. He currently contributes to several selection projects across Italy. He is also a member of the Navdanya International board, serving since its founding.

[6] For a deeper background on community seed banks and the principles of this approach, see Navdanya: About Navdanya.

[7] For victories on biopiracy and patent defense, see Navdanya International: About Us.

[8] See also Navdanya and allied movements for case studies on biodiversity-based farming and farmers' rights: About Navdanya.

[9] Navdanya's experience echoes this: community seed banks conserve, multiply, and exchange thousands of climate-resilient varieties that reliably withstand extremes—salt, flood, drought—not by genetic manipulation, but by honoring the complexity and subtlety of coevolution between seed, soil, and culture. Unlike industrial seeds, this living diversity empowers farmers, preserves seed sovereignty, and builds the true resilience needed for regenerative food systems in an era of climate chaos. Navdanya. "Seeds of Hope, Seeds of Resilience." 2017, https://navdanyainternational.org/publications/seeds-of-hope-seeds-of-resilience/

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# Seeds of Resistance :
## GMO Deregulation and Grassroots Defiance



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