Who has Control—Who has Sovereignty: A Case Study of Agricultural Gene Editing in the Global South

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UEP 410: Controversies in Policy and Politics
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11 December 2025

Introduction

This case study aims to shed light on the realities of implementing CRISPR/Cas genome-editing technology in the agricultural sector of the Global South. Agricultural gene editing is a technological innovation increasingly promoted as a solution for feeding growing populations in the midst of the global climate crisis. I analyze the research on agricultural genome modification and the growing popularity of CRISPR in Latin America and Africa through a case study that compares regional responses, policies, and discourse regarding the biotechnology adoption process. There is existing rhetoric that claims the implementation of CRISPR in Global South nations is generally being applied as an altruistic service in food-insecure and climate-vulnerable regions, but how much of that sincerely centers local voices, versus imposing outside solutions through a 'savior-complex' foundation without community input or collaboration? I intend to analyze perspectives and discourse from consumers, CRISPR shareholders/corporations, scientists, community organizations, and regional smallholder farmers to gain holistic insight into the effectiveness of current policies, while also developing suggestions for improving legislation surrounding the expansion of CRISPR. Using qualitative discourse analysis methods, the framework for this project will focus on concepts of "technological lock-in," "the double-edged sword of technology," and uneven power relations in the age of biotechnology (Clapp and Ruder, 2020). This framework will allow me to explore questions regarding different regions' agricultural equity, sovereignty, and autonomy, and how events, like this technology implementation, also affect global perceptions and reactions to said regions. For instance, is the myth of Africa's food insecurity a main justification to test CRISPR agriculture there rather than in one of the many food deserts in the United States? This case study seeks to respond to these questions and productively contribute to ongoing conversations on how to best approach this global issue.

Background/Context

The landscape of biotechnology in agriculture has undergone profound advancements over the past several decades, from traditional breeding methods to sophisticated molecular techniques. Relatively recent advances have introduced site-directed alterations that offer unprecedented precision in genetic alterations (Bhuyan et al., 2023). Among the emerging technologies, CRISPR-Cas systems have emerged as the most revolutionary and widely adopted platform for genome editing. Early gene editing tools like Zinc Finger Nucleases (ZFNs) and Transcription Activator-Like Effector Nucleases (TALENs) were groundbreaking but faced significant limitations. ZFN required complex and expensive design processes for each target sequence, with limited available target sites and potential for off-target effects due to non-specific DNA binding. TALENs presented technical challenges in synthesis due to the repetitive nature of their DNA-binding domains, leading to reduced precision and target-cutting efficiency (Bhuyan et al., 2023). These limitations created the need for more accessible, efficient, and cost-effective gene editing solutions.

CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) was a revolutionary breakthrough in genetic engineering that had transformative implications for healthcare and agricultural improvement. Originally discovered as part of a naturally occurring bacterial immune system process, CRISPR functions like "molecular scissors" that can precisely cut and modify DNA sequences at specific locations within a plant's genome (Ahmad et al., 2023). The system harnesses single-stranded guide RNA (sgRNA) and the Cas enzyme to manipulate genomes with specificity and efficiency. The technology works as follows: scientists design a guide RNA (gRNA) composed of CRISPR RNA (crRNA) and transactivating crRNA (tracrRNA) to direct the Cas protein to a target DNA sequence, where it creates a double-strand break (DSB). The plant's repair mechanisms, more reliably homology-directed repair, would then fix this break, potentially introducing precise changes that can alter gene function or expression (Bhuyan et al., 2023). This precision allows scientists to enhance desirable traits such as drought tolerance, nutritional content, or disease resistance without introducing DNA from unrelated organisms.

CRISPR fundamentally differs from traditional genetic modification, such as the genetic changes introduced. Traditional genetically modified organisms (GMOs) typically involve the insertion of foreign genes from completely different species, such as incorporating bacterial genes into plants to confer pest resistance (Ahmad et al., 2023). These modifications introduce entirely new genetic elements that would never occur naturally through conventional breeding or natural mutation processes. In contrast, CRISPR technology can achieve beneficial traits through precise modifications of a plant's existing genetic material, often producing changes that are indistinguishable from those that could occur through natural mutation or conventional breeding. CRISPR allows for targeted modifications that may involve no foreign DNA. This difference has profound implications for both regulatory classification and public opinion.

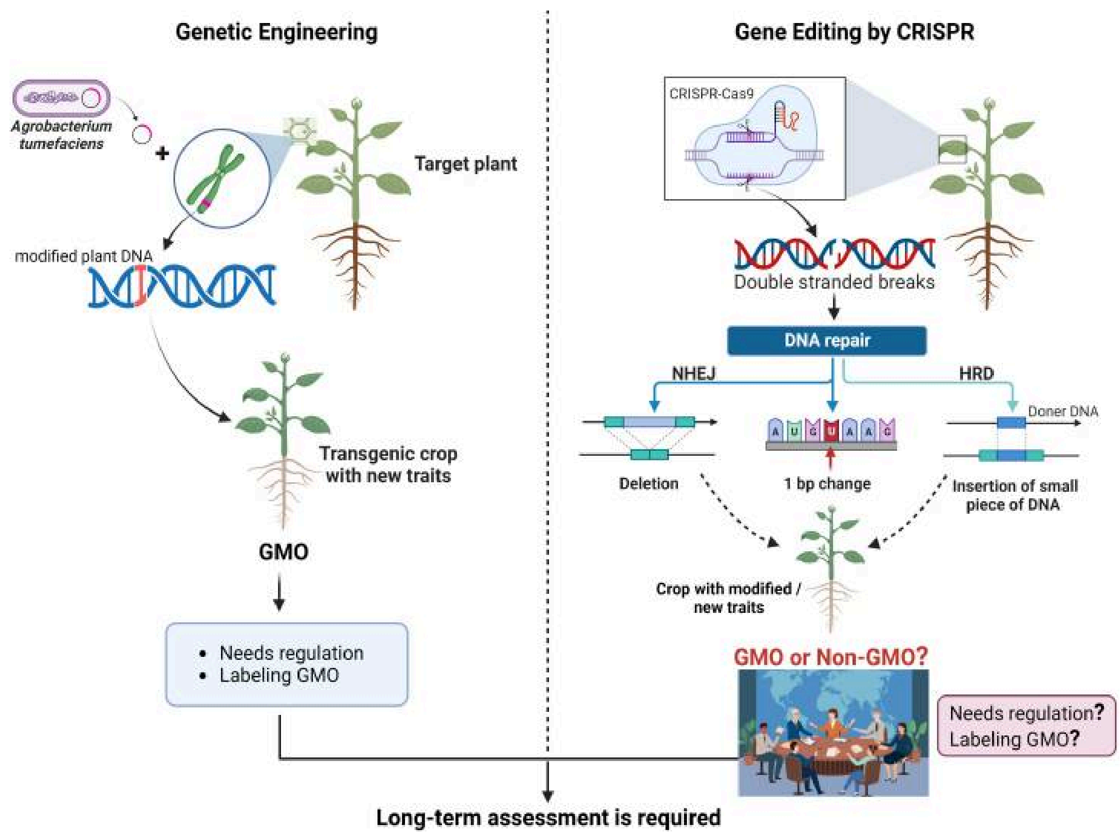

Figure 1. *Visual showing the difference between CRISPR and GMO gene editing technology process (Ahmad et al., 2023).*

CRISPR gene editing applications in agriculture have demonstrated remarkable potential for addressing global nutritional challenges through biofortification, the process of increasing the nutrient content of crops. Recent successes include the development of rice varieties with increased iron and zinc content, wheat with reduced gluten content for celiac patients, tomatoes with enhanced lycopene levels, and crops with improved fatty acid compositions (Kaya, 2025; Bhuyan et al., 2023). The technology's precision also allows for the development of crops that combine multiple beneficial traits—a process known as trait stacking. For instance, researchers have successfully created biofortified crops that simultaneously possess enhanced nutritional profiles and improved stress tolerance, allowing them to maintain their nutritional value even under challenging environmental conditions exacerbated by climate change. CRISPR has been particularly effective in engineering crops for abiotic stress responses, including drought, salinity, extreme temperatures, and heavy metal stress, while also addressing biotic stresses such as disease and insect resistance (Bhuyan et al., 2023).

The regulatory status of CRISPR products varies across different regions and has significant implications for technology adoption in Global South countries. The central debate revolves around whether CRISPR-edited crops should be classified as GMOs or traits as conventionally bred varieties. Regulatory authorities have developed classification systems based on the extent and nature of genetic modification involved. Site-Directed Nuclease types 1 and 2 (SDN1 and SDN2) modifications introduce small changes without incorporating foreign DNA, making them indistinguishable from naturally occurring mutations. In contrast, SDN3 modifications involve inserting larger DNA fragments, similar to traditional engineering approaches (Ahmad et al., 2023; Bhuyan et al., 2023). Countries adopt either product-based or process-based regulatory approaches. Product-based systems, adopted by countries like the United States, Argentina, Brazil, and Nigeria, focus on the final product's characteristics rather than the method used to create it. Under these frameworks, SDN1 and SDN2 crops are often treated as non-GMOs that can bypass traditional regulatory restrictions. Meanwhile, process-based systems, exemplified by the European Union, classify all CRISPR-edited crops as GMOs regardless of whether they contain foreign DNA, based on the biotechnological process used to create them (Bhuyan et al., 2023). This regulatory disparity creates challenges for international trade and technology transfer, particularly affecting how Global South nations approach CRISPR adoption. The complexity of these regulatory frameworks can create new forms of technological dependence, even as the technology poses great potential to address local agricultural challenges.

The emergence of CRISPR has generated starkly divergent narratives among stakeholders, each framing the technology's potential through distinct lenses. Corporations generally position CRISPR as essential for sustainable agricultural innovation. Major agribusiness companies like promote precision technologies as tools for reducing chemical use, enhancing resource efficiency, and addressing climate challenges through more targeted agricultural interventions (Clapp and Ruder, 2020). In contrast, many civil society and farmer organizations express deep skepticism about CRISPR implications, warning that corporate concentration of agricultural data threatens farmer autonomy and reinforces an industrial model that perpetuates environmental harm (Clapp and Ruder, 2020). Scientific and research communities present a more nuanced view, arguing that biotechnology can help achieve organic agriculture's goals, but may be fundamentally incompatible with principles of biodiversity, farmer autonomy, and equitable food systems due to its embeddedness in corporate-controlled frameworks (Montenegro de Wit, 2022). These rhetorics war with each other, particularly in Global South regions, where decision-makers are desperate for agricultural solutions while being cautious of top-down technological solutions that would concentrate Global North corporate control (Osendarp et al., 2018).

Literature Review

Global Context of Agricultural Technology and Food Security

Agricultural biotechnology has emerged as a significant tool for addressing global food security challenges, especially with the growing threat of climate change's effects on current crops trying to feed a projected nine billion people by 2050. Research suggests that sustainable agriculture practices must facilitate a 70% increase in global food production to meet these demands, making innovative technologies critical for agricultural transformation (Akinbo et al., 2025). CRISPR/Cas genome editing has introduced the potential to fight plant disease and crop degeneration at a more affordable cost, with no undue burden to human or environmental health (Ahmad et al., 2021). However, the distribution of these benefits remains a highly contested topic due to uneven access and control patterns across regions and populations.

Food fortification and biofortification programs provide important precedent for understanding how agricultural technologies can either reduce or exacerbate inequalities. In an analysis of large-scale fortification initiatives across low and middle-income countries to address micronutrient deficiencies, evidence revealed that despite the increasingly larger reach of these programs, successful programs require not only technical efficacy, but also attentiveness to local contexts, regulatory frameworks, and implementation barriers that particularly affect marginalized populations (Osendarp et al., 2018).

Research demonstrates that CRISPR technology offers substantial potential for addressing region-specific agricultural challenges in the Global South. Amombo et al. (2025) identify specific opportunities for enhancing crop nutrition in arid and semiarid regions of Africa, showing how single-gene edits could improve nutritional profiles of drought-tolerant crops while maintaining climate resilience. Similarly, Kaya (2025) documents successful biofortification efforts that combine nutritional enhancement with stress tolerance, creating dual-purpose crops particularly relevant for climate-vulnerable regions. These studies establish the technical feasibility of using CRISPR to address malnutrition and climate adaptation, addressing core challenges in Global South agriculture.

However, the global regulatory landscape for genome-edited crops reveals significant disparities in how different regions approach these technologies. Many countries in Latin America and Africa have adopted product-based regulatory approaches, which do not consider many CRISPR-edited crops to fall under traditional GMO regulations because they lack a transgene, allowing for certain deregulation of CRISPR products. Meanwhile, other regions, including the EU, maintain process-based regulations that treat any genome-edited crops similarly to traditional GMOs, resulting in more inflexible adoption of CRISPR agriculture (Ahmad et al., 2021). Dannenberg's (2009) meta-analysis also reveals significant regional divergence in consumer preferences, with Europeans being more averse to gene-edited foods than Africans. This disparity suggests that the implementation of biotechnology may follow uneven patterns, potentially creating situations where Global South regions become testing grounds for technologies rejected in the Global North, while also raising questions about the correlation between regulations and regional public opinions of CRISPR.

The discourse around CRISPR implementation in Global South contexts increasingly centers on questions of sovereignty—who controls agricultural technologies, who benefits from their development, and who bears the risks of their deployment. Food sovereignty movements have long articulated critiques of top-down technological interventions, and CRISPR's emergence has intensified these debates around technological autonomy and democratic governance.

Montenegro De Wit (2019) documents how civil society organizations across the Global South have raised fundamental questions about CRISPR's compatibility with food sovereignty principles. More than 200 farmer, peasant, and civil society organizations worldwide, including the International Federation of Organic Agriculture Movements (IFOAM), the African Food Sovereignty Alliance, and La Vía Campesina, have called for moratoriums on gene drive technologies. These organizations argue that such biotechnologies threaten farmers' rights and the right to "healthy, ecologically-produced and culturally appropriate food and nutrition," as articulated by former UN Special Rapporteur on the Right to Food Olivier De Schutter.

The concept of technology sovereignty emerges as a framework for addressing these concerns, extending beyond simple access to encompass community control over technological development processes. Montenegro de Wit (2022) proposes six principles for technology sovereignty that parallel food sovereignty tenets: technology should be developed for people rather than profit, should value food providers as technology providers, should localize both technology systems and control, should build on Indigenous and local knowledge systems, and should work with rather than against natural processes. This framework challenges the assumption that greater access to technology automatically translates to social benefit, pointing instead to historical evidence from the Green Revolution showing how technological access often exacerbated rather than reduced inequalities.

Critical analysis reveals how CRISPR development often follows what Beumer and de Roji (2023) term a "spacecraft approach," where technologies are designed for Global South farmers without meaningful participation in problem identification or solution development. This pattern reproduces colonial dynamics where external actors define problems and impose solutions on communities that become recipients rather than co-creators of technological innovation. The concentration of CRISPR intellectual property among multinational corporations further compounds these concerns, as patent holders like Corteva Agriscience control access to foundational technologies through licensing agreements that may limit local innovation capacity.

Successful implementation requires careful attention to local contexts, including the need for transparent community engagement and the deployment of local scientific capacity. Implementation barriers include the necessity for careful testing protocols and the critical importance of local ownership of the technology development process (Ogaugwu et al., 2019).

Technological Lock-in and Power Dynamics

The concept of technological lock-in provides a framework for understanding how existing agricultural systems shape the trajectory of new biotechnologies. Clapp and Ruder (2020) examine precision technologies for agriculture, including genome editing through three analytical dimensions: technological lock-in, double-edged technology effects, and power distribution dynamics. Their analysis reveals that the strong lock-in of dominant industrial agricultural models enables proponents to position CRISPR as the logical next innovation for agriculture, while encouraging critics to call for complete transformation toward agroecological systems. This dynamic created polarized debates between competing technological systems than nuanced assessment of implementation approaches rather than a nuanced assessment of implementation approaches.

Technological lock-in occurs when powerful social forces drive technological development along established pathways that become increasingly difficult and costly to change. In agriculture, the progressive adoption of hybrid seeds, monoculture practices, and agrochemical systems has created path dependencies that shape how new technologies like CRISPR are developed and deployed. Current CRISPR applications often focus on enhancing existing crop varieties within industrial agricultural frameworks rather than supporting alternative production systems (Clapp and Ruder, 2020). Beumer and de Roji (2023) provide empirical evidence for these power dynamics through their systematic analysis of 30 gene editing projects targeting smallholder farmers. Their research revealed that most follow a "spacecraft approach" where technologies are designed for smallholders without their meaningful input, only engaging communities after development is complete. Of the 30 projects analyzed, only six involved smallholder farmers in problem identification and technology design phases. This finding demonstrates how technological lock-in operates at the design level, where existing research and development structures shape who participates in defining technological problems and solutions.

Applying the double-edged technology dimension from Clapp and Ruder's framework, current CRISPR development patterns show potential for both democratizing and concentrating agricultural control. While gene editing tools are less expensive than previous biotechnologies and some intellectual property holders offer academic licenses, high regulatory compliance costs and patent restrictions may limit access for public sector researchers and smaller developers Intellectual property regimes have historically concentrated agricultural biotechnology control among multinational corporations with genome editing (GM), creating licensing barriers for public sector development, especially in the Global South (Bennett et al., 2013).

Regional Policy Frameworks and Implementation Patterns

Regulatory approaches to genome editing reveal how policy decisions shape technology access across different regions. Zarate et al. (2023) analyze agricultural gene editing regulation across nine Latin American countries, documenting how policy entrepreneurs use specific political windows to influence technology governance. Their study, based on 41 interviews with regulators, scientists, and activists, shows that regulatory outcomes reflect political negotiations rather than purely technical considerations. Argentina and Brazil exemplify more permissive regulatory approaches. Argentina's National Advisory Commission evaluates gene-edited products based on whether they contain novel genetic combinations, exempting products without transgenic material from GMO regulations. Brazil's regulations create expedited review processes for gene-edited products that do not contain recombinant DNA. Meanwhile, other countries, such as Peru, have adopted more restrictive approaches based on environmental concerns and civil society pressure. Peru's moratorium on genetically modified organisms applies to genome editing despite technical differences from traditional genetic modification. This restriction emerged after unauthorized GM corn was discovered in 2008, creating political pressure that civil society organizations used to advocate for broader technology restrictions.

Akinbo et al. (2025) examine policy landscapes across Kenya, Nigeria, Ghana, Malawi, Mozambique, and Burkina Faso, documenting how countries adapt existing biosafety frameworks for genome editing applications. Kenya's National Biosafety Authority established early consultation processes allowing case-by-case assessment of regulatory requirements. Nigeria amended its biosafety laws in 2019 to explicitly include genome editing, creating separate pathways for products with and without transgenic material—not unlike Argentina's regulations. However, South Africa's stance of regulating genome-edited crops under existing GMO regulations may echo and perpetuate persistent public distrust of the new technology. Additionally, public investment in agricultural research and development across African countries averages only 0.42% of GDP, compared to a global average of 1.7%. This investment gap limits the capacity for developing locally relevant genome editing applications and may increase dependence on technology transfer from external sources. Akinbo et al. call for robust educational investment, public engagement, and adaptive regulatory frameworks to help bridge knowledge gaps and safely deploy innovative technological solutions for general public health.

Furthermore, research on public acceptance reveals additional layers of inequality in biotechnology implementation. Hu et al. (2022) demonstrate that consumer acceptance of gene-edited foods depends heavily on information delivery methods, with infographics and video proving more effective than text descriptions commonly used in policy communications. Their experiments, involving 1,200 participants, found that infographics increased acceptance rates by 23% compared to text-only descriptions, while video presentations increased acceptance by 31%. These findings have critical implications for equitable access because effective information delivery varies across populations with different literacy levels and media access.

Democratic Governance and Equity Assessment

The literature increasingly calls for more comprehensive approaches to evaluating biotechnology that examine distributional effects and democratic participation alongside technical capabilities. Clément and Ajena (2021) used FAO's 10 Elements of Agroecology as an assessment framework, revealing how CRISPR applications often conflict with principles of democratic governance and the circular economy. Their analysis demonstrates that current CRISPR development patterns exhibit significant incompatibilities with sustainable food systems' social and economic dimensions. Subica (2023) also provides a critical public health perspective, identifying specific mechanisms through which CRISPR technologies may exacerbate health disparities among marginalized populations. The historical exclusion of minority communities from genomic research threatens to reduce both efficacy and acceptance of CRISPR therapies among populations who bear the greatest health burdens, creating a paradox where those who could benefit most are least likely to receive equitable access.

Clapp and Ruder (2020) argue that current CRISPR development patterns often conflict with principles of democratic governance, and that democratic governance of agricultural technologies requires attention to who participates in problem definition, technology design, and implementation decisions. This governance challenge extends beyond individual technology projects to broader questions about research priority-setting and resource allocation. The power distribution analysis also reveals how patent systems and regulatory requirements create barriers for public sector and smaller-scale technology development. Understanding these governance dynamics is essential for evaluating whether CRISPR implementation follows patterns that concentrate or democratize control over agricultural systems.

Research Design

This case study examines primary source documents across multiple categories to find patterns and themes that seek to answer the research questions. I analyze policy and regulatory documents from my focus regions in the Global South—primarily Africa and Latin America—including regulatory guidelines and national biosafety frameworks. I also examine corporate and scientific documents from major agricultural biotechnology corporations and international development organizations to explore how CRISPR technologies are positioned in Global South contexts. These documents may include press releases, annual reports, marketing materials, and research partnership agreements. I supplement this with media and public discourse from international and regional sources, including news coverage and editorials, to understand the different framing patterns. Finally, I review documents from the community and social organizations to capture local voices through public statements and campaign materials.

This study employs discourse analysis and systematic content analysis to examine the contested narratives surrounding CRISPR/Cas genome editing implementation in Global South agriculture. Drawing on Feindt and Oels' (2005) conceptualization of discourse analysis in environmental policy making, this research recognizes that agricultural biotechnology problems are not self-evident but rather "socially constructed, building on expert language and concepts, research practices and available technology" (p. 162). The choice of discourse analysis is particularly appropriate for this study because, as Feindt and Oels note, "environmental discourse is part of a broader discursive landscape" where competing discourses—economic, development, and sovereignty—contest the framing and solutions to agricultural challenges (p. 162).

The study utilizes descriptive coding to uncover themes such as risk/benefit framing, benefit distribution discussions, and stakeholder positioning (Saldaña, 2016, p. 87). This initial coding serves what Saldaña describes as the fundamental purpose of summarizing "the primary topic of a passage of data" (p. 87), creating a foundation for deeper analytical work. Then, Values Coding is employed to identify "a participant's values, attitudes, and beliefs, representing his or her perspectives or worldview" (Saldaña, 2016, p. 131) embedded in stakeholder communications about CRISPR. This approach is particularly important for understanding how different actors position themselves relative to questions of technological necessity, agricultural sovereignty, and development priorities. After this initial cycle of coding, Pattern Coding is used to identify “emergent themes, configurations, or explanations” across the data corpus (Saldaña, 2016, p. 236). This process generates the primary discourse categories identified in the analysis.

Clapp and Rudder's (2020) framework identifies gaps between technological optimism and potential social consequences throughout the research process, particularly analyzing whether immediate benefits for Global South regions mask longer-term risks or dependencies. This will inform regulatory frameworks that balance innovation promotion with protection against technological “lock-in” that could undermine local agricultural autonomy or sovereignty. This approach illuminates significant dimensions for future policy and practice, and this analysis will reveal disparities between inclusive innovation rhetoric and actual participatory practices, informing recommendations for genuine community-based approaches to technology implementation. The analyses can expose how implementation patterns either challenge or replicate existing power structures, informing equitable access policies. The cross-regional regulatory comparison will identify frameworks that best balance innovation with community protection and autonomy. A look into communication equity will reveal that information disparities affect implementation, building on research showing that communication methods significantly impact public acceptance.

Bringing these sources together, I aim to highlight the regulatory practices in the Global South to deepen our understanding of moving beyond technocratic solutions, toward frameworks that actively shape how agricultural biotechnology develops and deploys across various regional contexts through local autonomy and long-term sustainable practices—especially in the context of an increasingly warming Earth.

Analysis

The discourse surrounding CRISPR gene editing in agriculture throughout the Global South is a starkly contrasting array of sentiments encompassing corporate technological optimism, peasant resistance movements, and varied regulatory approaches. Examining stakeholder positions across Latin America and Africa, with a focus on Peru and Nigeria, three dominant narratives emerge that contest the future of agricultural development and food sovereignty in these regions. Throughout the analysis, Clapp and Ruder’s (2020) framework will provide useful tools for understanding and analyzing the power dynamics embedded in CRISPR discourse.

The “Modern Solution” Narrative

The most blaring discourse frames CRISPR as an essential modern solution to the increasing agricultural challenge of feeding the rapidly growing population in already highly food-insecure and climate-vulnerable regions (NASAC, 2022). This narrative is mostly dominated by the European corporations’ leading players in CRISPR plant breeding: BASF, headquartered in Germany, and Limagrain, from France (Data Bridge Market Research, 2022). BASF’s investments in African emerging markets reveal the strategic targeting of vulnerable regions for technology deployment, with the company positioning itself as addressing “crop protection in Africa” while expanding its market reach (Hopkins, 2019). The corporate messaging consistently emphasizes CRISPR's many potential benefits as the future of agriculture and sustainability, while partnering nations and scientists position proper regulation as the primary concern, rather than questioning the fundamental need for technology (Hopkins, 2019). This rhetorical strategy effectively shifts the debate from whether CRISPR is necessary to merely how it should be implemented, foreclosing fundamental questions about alternative agricultural approaches.

Scientists overwhelmingly advocate for CRISPR as a modern solution, creating what appears to be a scientific consensus around technological necessity. Training programs like the "AfBA CRISPR Class III Training to empower Africa's Crop Improvement Scientists" exemplify how scientific capacity building becomes embedded in pro-gene-editing discourse (IITA, 2025). The discourse frames CRISPR as "critical" to solving Africa's nutritional insecurities and challenges faced by smallholder farms, but this "empowerment" happens to simultaneously channel research priorities toward genetic engineering rather than alternative approaches, without consulting the farmers' inputs.

This discourse is particularly pronounced in Africa, where CRISPR is framed as essential for addressing climate and food vulnerability challenges. There is even narrative positioning of CRISPR as emerging from "Europe's anti-GMO shadow", suggesting that African adoption represents liberation from European regulatory constraints (Maina, 2025), yet this statement fails to acknowledge that the primary beneficiaries remain European corporations. Furthermore, the dominance of the European corporations demonstrates technological lock-in, where "dominant technological systems establish path dependence for subsequent technological innovations" (Clapp & Ruder, 2020). BASF and Limagrain represent the perpetuation of industrial agricultural systems that have historically concentrated power in multinational agribusiness. This lock-in "can ultimately crowd out other potential technological systems that might offer more benefits over the long run" (Clapp and Ruder, 2020).

Sovereignty and Biodiversity Resistance

While scientists, corporations, and policymakers discuss CRISPR gene editing's benefits, actual farmers remain largely excluded from these conversations. In direct opposition to corporate narratives, rural and peasant seed farmer movements articulate a discourse centered on limiting biotechnology and centering on food and seed sovereignty (La Via Campesina, 2023). La Via Campesina, a global coalition of and for indigenous people, small and medium farmers, peasants, and more, defends their position on seed diversity and calls for strict regulation of genetic engineering. They warn against transnational and technical associations working together to deregulate agricultural biotechnology, saying the first wave of genetic engineering not only increased the hunger epidemic, but also drove countless farmers into corporate agricultural dependence and debt (La Via Campesina, 2023).

The emphasis on sovereignty positions traditional seed systems as both technically superior and politically necessary for maintaining farmer independence. La Via Campesina groups demand climate reparations from the Global North and global policy direction in peasant agroecology (La Via Campesina, 2025). This general perspective draws particular strength from historical patterns of corporate control, particularly regarding concerns about Limagrain's acquisition of Africa’s farmer-led, largest seed company, SeedCo, representing “neo-colonial occupation of Africa’s seed systems” (Ababa, 2014). These historical precedents provide evidence that corporate promises of partnership often result in corporate control.

Peru exemplifies this resistance discourse most clearly through its moratorium on GMOs and gene editing, emphasis on community seed banks, and explicit concern about gene diversity (Vernooy & Ramirez, 2025). The country’s community seed banks represent practical alternatives to corporate seed systems, maintaining “Peru’s agrobiodiversity zones” through farmer-controlled conservation practices. The BBC’s documentation of “the guardians of Peru’s potato park” showcases sophisticated traditional knowledge systems that maintain crop diversity without corporate intervention (Oakes, 2023). Additionally, the draft Law on Traditional Native Seed Systems, submitted to Congress by agrarian and indigenous community organizations, represents an institutionalized version of this resistance, seeking legal protection for traditional agricultural practices against technological encroachment (La Via Campesina, 2025).

Figure 2. *Berlin 2025 Global Forum for Food and Agriculture*
Sign Reads: “Access to Seed Diversity instead of Dependence on Biotechnology corporations” (La Via Campesina, 2025).

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SCIENCE

Bill Gates says it would be a 'tragedy' to pass up a controversial, revolutionary gene-editing technology

By Kevin Loria

Figure 3. *Business Insider headline covering Bill Gates's endorsement and investment in CRISPR technology (Loria, 2018).*

National Sovereignty and Regulatory Pragmatism

Another discourse emerges around national positioning and regulatory frameworks, exemplified by Nigeria's product-based, case-by-case regulations that approve GE products as long as they don't have recombinant DNA in their final product (Boluwade, 2021). Nigeria's position as the first African country to legally embrace gene editing, immediately differentiating it from GMOs, reveals how regulatory frameworks can simultaneously claim sovereignty while facilitating corporate dependence.

Nigeria's claim to "biotechnology sovereignty" (Maina, 2025) becomes quite questionable when the biggest CRISPR players remain European corporations, suggesting that regulatory sovereignty may mask rather than address technological and economic dependence. Furthermore, the European Union's own reluctance to genetically modify and engineer products might reveal its corporations' entanglement with Nigeria's agricultural landscape to be questionable (Boluwade, 2021). Because while the EU prides itself on its wholly organic, natural products, regulatory strategies like Nigeria's allow corporations to market CRISPR products as fundamentally different from controversial GMOs while maintaining corporate control over African seed systems.

Latin America generally presents a more economically-driven sovereignty discourse, with several nations embracing gene editing to position the region as a "global leader in agricultural innovation" (Ventura, 2022). The Latin America Plant Breeding and CRISPR Plant Market reports project substantial growth through 2032, indicating significant corporate investment in regional markets (Data Bridge Market Research, 2022). This positioning explicitly connects CRISPR adoption to trade competitiveness in Latin America, making CRISPR adoption an economic imperative that gives the region more economic standing (Ventura, 2022).

Shifting Discourses

Recent developments reveal the dynamic and contested nature of these discourses. Despite Peru's strict moratorium, some researchers have begun pushing consideration of gene editing "to protect potatoes", representing a potential shift in resistance discourse when confronted with immediate agricultural threats (ARGENPAPA, 2025). This shift in discourse is particularly significant given the country's role as a center of potato biodiversity and traditional agricultural knowledge (Oakes, 2023). This development transforms traditional crop protection into justification for gene editing biotechnology.

Meanwhile, corporate discourse increasingly incorporates sustainability and climate arguments to frame CRISPR as more and more essential. This shift allows proponents to position CRISPR as environmentally necessary while avoiding questions about the environmental impacts of industrial agriculture more broadly. Clapp and Ruder (2020) identify this pattern as technology's "double-edged nature", where technological optimism obscures potential negative consequences.

The CRISPR discourse in the Global South reveals fundamental disagreements about agricultural futures, technological necessity, and the meaning of sovereignty. While corporate and scientific voices promote CRISPR as an inevitable modern solution, farmer and indigenous movements and some national responses assert alternative routes based on biodiversity, traditional knowledge, and democratic control over agricultural technologies. Ultimately, the CRISPR discourse reveals the need for more democratic and farmer-centered approaches to agricultural technology development that prioritize food sovereignty over corporate profits.

Recommendations

Based on the discourse analysis revealing how CRISPR implementation in the Global South risks perpetuating colonial patterns of technological control, this case study offers three primary recommendations for different stakeholder groups. These recommendations address the power imbalances identified in current CRISPR development while building on existing frameworks.

Recommendation 1: Implement Participatory Technology Assessment Protocols for Researchers and Development Organizations

The analysis reveals a critical gap in current CRISPR development approaches, with Beumer and de Roji (2023) finding that only six of 30 gene editing projects targeting smallholder farmers involved them in problem identification and technology design phases. This "spacecraft approach" reproduces colonial dynamics where external actors define problems and impose solutions on communities. Researchers and development organizations should adopt Montenegro de Wit's (2022) technology sovereignty framework, which emphasizes that technology should be developed for people rather than profit and should build on Indigenous and local knowledge systems.

There are precedents in participatory research methodologies, and funders are increasingly recognizing the importance of community engagement. Organizations like the Alliance for a Green Revolution in Africa (AGRA) and international development agencies increasingly require stakeholder consultation in project proposals (AGRA, 2025). However, implementation requires moving beyond superficial consultation to genuine co-creation of research priorities. This involves training researchers in participatory methods, providing funding for extended community engagement periods, and structuring academic incentives to reward collaborative research practices. The evidence suggests this approach is not only ethically necessary but also technically beneficial. As demonstrated by Peru's community seed banks, which maintain sophisticated biodiversity conservation systems (Oakes, 2023), local communities possess extensive agricultural knowledge that can enhance technological innovation. The challenge lies in overcoming institutional barriers within research organizations and funding agencies that prioritize quick deployment over democratic participation.

Recommendation 2: Establish Adaptive Regulatory Frameworks that Prioritize Local Control for National Governments

There are significant regulatory disparities between regions, with some countries adopting permissive product-based approaches while others have restrictive process-based regulations. However, both approaches often fail to address fundamental questions of technological sovereignty and democratic governance (Akinbo et al., 2025). National governments should develop adaptive regulatory frameworks that combine technical assessment with strict evaluation of distributional effects and community control mechanisms. Nigeria's case-by-case assessment, for instance, requires strengthening to address power dynamics. The country's National Biosafety Authority has established consultation processes for genome-editing applications (Akinbo et al., 2025), but these primarily involve scientific and regulatory experts rather than affected communities. An adaptive framework would incorporate practices such as mandatory community impact assessments, demonstrating local benefit rather than merely the absence of harm, and establishing mechanisms for ongoing community oversight of approved technologies.

The feasibility of this recommendation is supported by existing legal frameworks for environmental and social impact assessment that many countries already implement for large development projects. Peru's draft Law on Traditional Native Seed Systems, submitted by agrarian and indigenous organizations (La Via Campesina, 2025), demonstrates how communities can actively participate in regulatory development. However, implementation requires significant capacity building within regulatory agencies and may face resistance from corporate interests seeking easy approval processes. The investment in regulatory capacity is justified by the need to avoid the technological lock-in patterns that have historically concentrated agricultural control among multinational corporations (Clapp and Ruder, 2020).

Recommendation 3: Support Public Sector Innovation and Open-Source Technology Development for International Development Organizations and Funders

The corporate dominance of CRISPR development, particularly by European companies like BASF and Limagrain operating in African markets, creates concerning patterns of technological dependence (Hopkins, 2019). International development organizations and funders should prioritize investments in public sector gene editing capacity and open-source technology platforms that enable local innovation rather than technology transfer. This recommendation addresses the power distribution dimension identified by Clapp and Ruder (2020), where patent systems and regulatory requirements create barriers for public sector development. Current public investment in agricultural R&D across African countries averages only 0.42% of GDP compared to a global average of 1.7% (Akinbo et al., 2025), limiting capacity for developing locally relevant applications. Increased public investment could support the development of gene editing tools and applications specifically designed for local crop varieties and farming systems rather than adapting corporate technologies developed for industrial agriculture.

Successful precedents in public sector biotechnology development include the International Rice Research Institute's work on biofortified rice varieties and various national agricultural research systems (IRRI, n.d.). However, implementation requires sustained long-term investment commitments that may conflict with shorter funding cycles typical of development aid. The technical capacity exists, as demonstrated by successful training programs like the AfBA CRISPR training initiatives (IITA, 2025), but these currently direct researchers toward corporate-controlled platforms rather than independent innovation capacity. The evidence from food fortification programs demonstrates that successful interventions require attention to local contexts, regulatory frameworks, and implementation barriers affecting marginalized populations (Osendarp et al., 2018). This suggests that public sector innovation must be accompanied by community engagement and democratic governance mechanisms to avoid reproducing patterns of top-down technological intervention under different institutional arrangements.

These recommendations collectively address the fundamental challenge identified in the discourse analysis: how to harness CRISPR's technical potential while avoiding the concentration of agricultural control that has historically characterized biotechnology development in the Global South. Implementation requires coordinated action across multiple stakeholder groups and sustained commitment to democratic governance principles that prioritize food sovereignty over technological optimism.

Conclusion

CRISPR gene editing technology is a powerful tool that is growing in research and application in the global agricultural context with each passing year, and the biggest stakeholders are too often overlooked in the ongoing discussions about it. Genetic editing has evolved remarkably into the resource-efficient and effective process it is today, but no amount of innovation has much meaning if it cannot be implemented properly, and there are numerous ways in which this technology can bring more harm than aid to those who need it most. Countless historical precedents of multinational corporations perpetuating and controlling industrial agriculture at the expense of the most vulnerable and marginalized suggest that this new wave of biotechnology is well on its way to repeating history. The discourse analysis reveals patterns of CRISPR gene editing being controlled and distributed by European corporations, resulting in mixed regulatory responses—neither fully addressing the benefits and risks attached to the technology—while farmer and Indigenous movements fight for food sovereignty and biodiversity. The historical cycle of these corporations forcing the Global South's technological and economic dependence on the Global North has created uneven power relations that many community organizations are constantly rejecting. Despite this, the optimistic promises from the scientific and corporate community do have public discourse constantly shifting and recognizing CRISPR's potential, which is desperately needed in the uncertain times of increasing climate vulnerability and food insecurity.

It is up to policymakers and regulators to ensure that the full benefits of promising biotechnology can be developed, managed, and utilized under regional autonomy—working for local needs and people, not industrial conglomerates that want to colonize food systems. This not only applies to decision-makers in Global South nations, but also to Global North and international institutional partners, such as the United Nations, to hold themselves accountable for the insurmountable damage they have caused or contributed to, by supporting the necessary infrastructure in the Global South to reclaim their sovereignty and independence. And it is up to us as the masses and the public to pressure the decision-makers into prioritizing people over profit at every given chance.

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