UNIVERSITY of VIRGINIA | NATIONAL SECURITY DATA AND POLICY INSTITUTE

POLICY ALTERNATIVES TO EMERGING AGBIOTECH THREATS

EXECUTIVE SUMMARY:
Agricultural biotechnology ("agbiotech") is a growing concern in U.S.-China competition due to potential dual-use capabilities, new supply chain vulnerabilities, and increased Chinese geopolitical leverage. While biotechnology broadly presents security risks, agbiotech warrants particular attention because of its direct impact on food security, an integral element of national security, and a perpetual focus for China. Emerging technologies, such as CRISPR and advanced biofoundries, introduce novel threats, ranging from enhanced agroterrorism to foreign manipulation of food systems, that could disrupt societies and erode U.S. readiness. To address these threats, this report proposes the following policy alternatives:

1. Establish Seed Genomic Data Protection Policy – Seed genomic data currently lacks sufficient federal protections. Policies should be enacted to classify certain seed and plant genomic data as national security assets.
2. Evaluate Food Supply Chain Vulnerabilities – The current understanding of China's agbiotech expansion and its impact on food supply chains (FSCs) is not well understood. Maps and other products should be created to analyze FSC dependencies and vulnerabilities.
3. Expand Agbiotech Counterintelligence (CI) – The agbiotech industry spends billions of dollars on research and development, often taking on years-long projects. Espionage aimed at agbiotech is relevant and ongoing. Agbiotech CI should be expanded to prevent threats against industry, government, and academic targets.

Protecting American agbiotech is critical for maintaining agricultural competitiveness and U.S. national security in an increasingly dynamic, technology-based era of competition.

INTRODUCTION:

The future of U.S.-China competition will be shaped by emerging technologies such as artificial intelligence (AI), next-generation energy, and agricultural biotechnology ("agbiotech"). Agbiotech applies modern biotechnology capabilities to agriculture, including genetic engineering, molecular diagnostics, and precision breeding.[i] These capabilities are being further enhanced by AI and advanced biofoundries. In agbiotech, AI is increasingly used to accelerate new trait discovery, predict crop responses to environmental stressors, optimize nutrient cycles, and monitor soil health and disease outbreaks. These new agbiotech capabilities are being accelerated by advanced biofoundries, which are facilities that can replicate ideal conditions for various organisms, allowing for rapid development of new biotech tools and products.[ii] When combined with gene-editing tools such as CRISPR, AI and advanced biofoundries can lead to exponential improvements in agbiotech efficiency and accuracy. This allows countries to produce larger crop yields and enhanced crop resilience, all essential for increasing food security.

CRISPR is a gene-editing technology that entered mainstream scientific use in 2015.[iii] In 2018, a team of Chinese scientists was able to modify the genes of two twin girls to make them immune to HIV[iv], raising ethical concerns related to biotechnology broadly. Agbiotech's capabilities only continue to expand, leading to greater control over natural processes and increased ethical concern; this trepidation is reflected in some countries' use of these technologies.

The U.S. has generally taken an open and supportive approach toward agbiotech and genetically modified (GM) crops.[v] Today, more than 90% of U.S. corn, cotton, and soybeans are GM products, and the average American consumes 29 pounds of GM corn annually.[vi] [vii] The production and consumption of GM products are made possible by the $3.5 billion of federal investment alone in the U.S. bioeconomy.[viii] This combination of investment and consumption makes food security an essential part of national security and an integral element of the broader U.S.-China competition.

China seeks to supplant the U.S. as the global leader in agbiotech.[ix] China has invested heavily in agbiotech to boost food security and sovereignty, but remains hesitant to allow GM products to enter its domestic market due to skepticism of GM products and biotechnology scientists themselves.[x] Despite domestic hesitation, Xi Jinping continues to advance biotechnology as part of his "New Era" security concept, which seeks to pursue security in all domains to control the "commanding heights of the future".[xi] China's 2020 *Science of Military Strategy* document further specified biotechnology as "*the* commanding height of the game between big powers", signifying a desire to outperform the U.S. in this critical area.[xii]

Agbiotech is an area of critical strategic importance. The consequences of failing to remain competitive in this space could be devastating. This report seeks to examine emerging agbiotech capabilities and associated threats, specifically dual-use capabilities, supply chain vulnerabilities, and geopolitical leverage. Further, this report proposes steps for the intelligence community, relevant policymakers, and businesses to take toward ensuring a more competitive, secure United States.

THREATS:

Dual Use Capabilities

"Dual use" refers to technology that can be used for both civilian and military purposes. In agbiotech, dual-use risk comes from the potential to weaponize biological agents, such as fungi, viruses, or other genetically engineered organisms, to deliberately damage crops. Seeds and crops are extremely vulnerable targets due to their fragility and strategic importance. Staple crops such as wheat and rice are ideal soft targets due to their ability to cause disproportionate harm.

Staple crops, such as wheat, rice, and corn, are particularly vulnerable to hostile action. Staple crops are the foundation of food security as they make up most of a country's caloric consumption.[xiii] While GM varieties of staple crops have been engineered to resist disease, pests, and adverse environments, they are not immune to biothreats. Advances in gene-editing tools like CRISPR or AlphaFold may allow adversaries to modify known pathogens or engineer new ones capable of overcoming current crop resistance.

One potential threat is Fusarium head blight (FHB), which is a disease that affects wheat, a global staple crop. FHB reduces crop yield and creates toxins that negatively impact human and animal health.[xiv] An outbreak of GM FHB would have drastic economic and health consequences. FHB is caused by a fungus, *Fusarium Graminearum*, which is often researched with the intent of mitigating FHB outbreaks. In June of 2025, two Chinese nationals were charged with smuggling *Fusarium* spores into the U.S.,[xv] under the guise of collaborating with other researchers. While one individual claimed the spores were intended for university-based research, this incident highlights the potential for accidental or intentional release of agricultural pathogens, which could greatly disrupt a country's food security. Even in the absence of hostile intent, unauthorized handling of high-risk agbiotech materials presents a serious threat to crop resilience, regional food security, and supply chains.

Food Supply Chain Vulnerabilities

China's rise in agbiotech creates cause for concern regarding various supply chains, especially those related to food. Food supply chains (FSCs) are particularly vulnerable due to the fragile nature of their core products: seeds and crops. FSCs have five parts: production, processing, distribution, consumption, and disposal, with the first three being the most susceptible to disruption. [xvi] Production encompasses planting and harvesting, processing refers to post-harvest procedures such as cleaning or packaging, and distribution involves the transportation of food products to distribution centers or consumers.[xvii] Of the three, China has recognized the transportation stage as its most vulnerable due to its reliance on imports.

China recognizes the strategic vulnerability of FSCs, particularly those dependent on imports.[xviii] One of the clearest examples of an import-dependent FSC is soybeans. China is the largest importer of soybeans in the world, importing 99.4 million tons in 2023.[xix] The majority of these soybeans come from three countries: the U.S., Brazil, and Argentina.[xx] Recognizing this dependence, China has aggressively expanded agbiotech research and development (R&D).[xxi] However, developing GM crops requires years of research and millions in investment. To bypass this, China has frequently resorted to agbiotech IP theft.[xxii]

In 2016, the FBI arrested a Chinese national, Mo Hailong, for attempting to steal trade secrets in the form of GM corn kernels.[xxiii] Hailong had purchased farms in Iowa and Illinois in an attempt to cover up his espionage, leading to him and his co-conspirators acquiring up to 250 pounds of stolen seeds.[xxiv] According to one of the companies affected by this IP theft, the targeted GM corn kernels could have cost the company five to eight years of R&D and more than $30 million in losses.[xxv]

China's economic ambitions in agbiotech also utilize a variety of legal means of expansion, such as acquisition. In 2017, a Chinese State-Owned Enterprise (SOE), ChemChina, acquired Syngenta, a Swiss agribusiness and a global leader in GM crop development.[xxvi] This acquisition resulted in ChemChina becoming one of the world's largest agrochemical and seed companies.[xxvii] As an SOE, ChemChina is ultimately beholden to the Chinese Communist Party and its interests. This merger represents not just a major threat to economic competition but a national security risk. Should mergers continue unmonitored, U.S. FSCs could be dependent on Chinese pesticides, crippling FSC resilience.

Geopolitical Leverage

China's growing investment in agbiotech is not only a domestic necessity but also a tool for expanding geopolitical influence, particularly in regions like Latin America and Africa. Domestically, China faces persistent food security challenges, stemming from limited arable land and a reliance on food imports.[xxviii] Despite food source diversification efforts, China remains vulnerable to disruptions in global food markets, causing Beijing to turn to agbiotech.

This internal demand has external consequences. As the Chinese agbiotech sector grows, it increasingly exports technology, such as GM seeds, pesticides, and agricultural drones, to developing countries. These technologies create dependencies that can be strategically leveraged. For example, Chinese agricultural drone maker XAG saw a 240% increase in revenue from exports to Southeast Asia and Latin America.[xxix] In Africa, China has signed many agricultural cooperation agreements and has established a regional Forum on China-Africa Cooperation.[xxx]

China's combination of technological exports, agricultural financing, and agricultural training represents a comprehensive effort to increase geopolitical leverage in developing countries. As these countries become more reliant on Chinese inputs, Beijing gains not just economic footholds but geopolitical leverage, potentially reshaping regional alignments.

POLICY ALTERNATIVES:

1. Establish Seed Genomic Data Protection Policy – While commercial policies exist to protect seed genomic data as intellectual property, there is no comprehensive policy to protect seed genomic data as a national security asset. The proposed Biosecure Act (H.R. 7085) protects human genomic data but not seed genomic data. Congress should create similar legislation that adds protections for seed genomic data, including export controls on staple crop genomic data and more stringent security protocols for experimental GM-focused fields. Proactive policies protecting access to seed genomic data should target traditional and experimental GM variants of staple crops, namely corn, soybeans, and wheat. Securing GM corn alone would protect 95% of the total feed grains produced and used, bolstering U.S. food security against foreign exploitation or bioterrorism.[xxxi]

A list of protected seed genomes should be created by the U.S. Department of Agriculture (USDA) and the Department of Homeland Security Science and Technology Directorate. This list should then be used as the foundation for seed-focused parallel legislation to a renewed Biosecure Act.

2. Evaluate Food Supply Chain Vulnerabilities – The U.S. lacks consolidated, accessible intelligence products detailing China's agricultural trade flows, particularly around experimental GM crops, which inhibits policymakers' ability to assess where and how China might be using agbiotech to gain geopolitical leverage. A coordinated economic intelligence mapping effort detailing FSC choke points, large agricultural suppliers and firms, and experimental GM crop flows would allow policymakers to recognize these dependencies and vulnerabilities, helping the U.S. and allies increase FSC resiliency and overall food security. A 2023 study estimated that the global trade of fruits, vegetables, and nuts contributed to a reduction in mortality of 1.4 million deaths globally.[xxxii] Further, a quarter of all consumed food crosses at least one border.[xxxiii] The impact of the food trade cannot be understated and must be understood. Food security is integral to national security, and food trade flows are critical infrastructure for the well-being of the U.S. and allies.

The National Geospatial Intelligence Agency, USDA, and the International Trade Association should cooperate to establish a team dedicated to producing and analyzing economic intelligence products. Once compiled, these products should be modified and cleared for public distribution to aid further research.

3. Expand Agbiotech Counterintelligence (CI) – Economic espionage is a pervasive threat, especially for the agriculture industry. Expanded agbiotech CI should aim to identify, monitor, and preempt espionage efforts using human intelligence and cyber surveillance of institutions and firms focused on agbiotech and experimental GM products. As demonstrated by the 2016 corn kernel case, private-public partnerships are key to thwarting foreign operatives targeting agriculture. Should foreign operatives be successful, years of research and billions annually would be lost, undermining U.S. agricultural competitiveness and biosecurity.

Policymakers, businesses, universities, the Federal Bureau of Investigation (FBI), and the USDA should more heavily scrutinize research partnerships, academic collaborations, and commercial transactions that could expose sensitive agbiotech research and technologies. Once an agbiotech CI task force is established, it should work closely with the Committee on Foreign Investment in the United States (CFIUS) to enhance its capabilities and scope.

These policy alternatives are a necessary foundation for protecting American agbiotech and food security. As agbiotech and biotechnology broadly continue to become more sophisticated, so do the threats. AI and other emerging technologies only make the threat environment more complex and dynamic. This means that policymakers, the intelligence community, businesses, and universities all have a stake in ensuring the future of American food security.

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