

# **Empowering Food and Agriculture to Respond as Critical Infrastructures to COVID-19 and Future Pandemics**

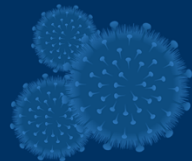
Part 3: Strategic Implications and  
Critical Infrastructure Vulnerabilities



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This publication is part of a partnership between Auburn University's McCrary Institute and Air University pursuant to which challenges related to cyber and critical infrastructure security are examined for the purpose of advancing U.S. national security.

# ABOUT US



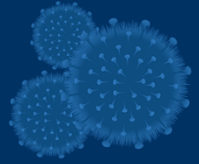
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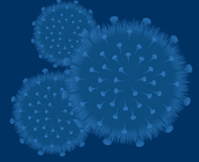
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# PART THREE



The coronavirus pandemic, known as COVID-19 has dramatically damaged the economy. Regardless of the epidemiology frictions being encountered, decision makers across the nation and across the world, have recognized the need for the reengagement of economies. At this juncture, it seems unlikely we will witness a shutdown on the scale that occurred in the early months of 2020. It is however expected we will see a variety of more focused, localized shutdowns until which time vaccinations on a global scale become available. Our nation has learned many hard lessons about managing pandemics. We are better able to do so than at the beginning. A great deal of global hope is being invested in vaccination. The positive effect of vaccinations is certainly anticipated. That being said, this optimism must be tempered to a degree with the reality that vaccination alone is never a panacea, but only a valuable tool that must be complemented by other strategies that combined will improve overall global health. As has been clearly illustrated by some of the demographic effects on COVID related morbidity and mortality, this virus, like all pathogens is not an entity in and of itself, but is rather influenced by other factors such as comorbidity and medical access. COVID must serve as a wakeup call that that threats to global health can travel from any place in the world to any other at the speed of air travel. The next pandemic is never more than hours away. This time the origin was China. The next one may be a repeat, or it could come from some other unexpected place. We need to prepare.

It is not the purpose of this paper to comment on the wisdom of any decisions made by leaders, other than to make a general observation that the other costs associated with this pandemic, (economic and psycho-social) appear to have escalated to the point that many decision makers have decided the associated risks of remaining shut down now outweigh the medical benefits of remaining at home. As we reengage, the consensus advice is to continue to remain socially distanced, even when going out in public or back to work. How that will work and how those decisions will either succeed or fail remains to be seen. The world has indeed changed in the wake of COVID-19.

## **Complexity Compounded**

During this time of reengagement a Black Swan event occurred in the United States, unexpectedly as always. "Black Swans" is the term used to describe unexpected events – surprise. When Black Swan events occur their effects, social, political and economic effects are often profound. On 25 May 2020, Minneapolis police officers arrested Mr. George Floyd, who had been accused by a local delicatessen employee of passing a counterfeit \$20 bill to pay for cigarettes. Upon his arrest and allegedly after some kind of scuffle, Mr. Floyd was pushed to the ground and his neck pinned by Officer Derek Chauvin. Mr. Floyd, who we now know had serious underlying medical conditions quickly reported to the officers that he was in distress. Officer Chauvin continued to press on his neck even after Mr. Floyd lost

consciousness and visibly stopped breathing. All of this was captured on a cell phone video, which was put on social media, rapidly going viral.

Officer Chauvin and three other officers were soon fired by the Minneapolis Police Department. Officer Chauvin was also shortly charged with 3<sup>rd</sup> Degree Murder and 2<sup>nd</sup> Degree Manslaughter on 29 May. Those charges were upgraded to 2<sup>nd</sup> Degree Murder on 3 June 2020. Protests of the killing began in Minneapolis on 26 May<sup>1</sup>. Peaceful protests in many major cities across the U.S. began on 27 May. Many of these quickly degraded into riots causing massive property damage and economic loss due to looting and arson. Beyond the human tragedy, loss of life and property, "...there have been demonstrations in every one of the 25 American communities with the highest concentrations of new virus cases."<sup>2</sup> A very high percentage of individuals participating in the peaceful and constitutionally protected protests, as well as the majority of rioters ignored the social distancing guidelines that had been so adamantly promoted by politicians as recently as a week before. This Black Swan landed squarely on top of a pandemic.

It is important here to note that these two contrasting types of activities are not being conflated here. The authors draw a clear distinction between constitutionally protected activities and criminal acts. Many in the peaceful protests continued to dutifully adhere to wearing personal protective equipment (PPE), i.e. masks, even though they may not have maintained the necessary social distancing of six feet. The majority of those that participated in the illegal acts (rioting, arson, assaults and vandalism) did not wear masks or maintain social distancing. The public health effects, which may never be reported, remain largely unknown at time of press.

Why is it important to include these disparate observations, given that neither specifically targeted the food supply or agriculture? Combined, these events have dramatically damaged the U.S. economy and have left our nation in a vulnerable state. Through all of the turmoil that has been 2020 to date, accompanying the good decisions and actions which have occurred, we have also witnessed mistakes and misjudgments that continue to send out aftershocks that threaten our nation's foundations. A weakened nation is one that needs to rapidly find solutions, for never let it be lost, that in times of national weakness, our nation's adversaries continue to watch and wait. We live in very perilous times. It is not unreasonable to posit our nation faces a confluence of perils that are of a magnitude, not experienced since the Second World War.

In several notable cases the collective bureaucracy (local, state and national) has failed both in expediency and right decisions. The collective problems could have two potential long-term effects on our society. 1) The "Cry Wolf" effect – warnings and guidelines were changed multiple times, sometimes contradicting each other. Once trust is lost, it is seldom gained

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<sup>1</sup> Taylor, Derrick Bryson "George Floyd Protests: A Timeline". Posted 2 June 2020. New York Times. Link: <https://web.archive.org/web/20200602235547/https://www.nytimes.com/article/george-floyd-protests-timeline.html>

<sup>2</sup> Source: <https://www.cbsnews.com/live-updates/george-floyd-death-protests-unrest-disorder-2020-06-02/>

back. 2) The break-down of U.S. civil society. Combined, the legitimacy of all authority has been brought into question. Our nation is rapidly moving toward strident, perhaps unalterable polarization, with each side increasingly dismissive and hostile toward the other. The last time this happened in the United States, our nation blundered into Civil War. Some believe we are close to that now. Most worrisome, a growing portion of our society, though still relatively few in numbers, welcomes the potential dissolution of our nation. A divided state will not be able to protect the public health.

Whole neighborhoods have already been destroyed by violence, including retail food outlets. In many of the poorer neighborhoods, retail food may never return, particularly those smaller operations that also provided income to some of the very people living there. These same neighborhoods concurrently experienced medical access and outcome disparities that COVID exposed. "Food Deserts" expanded in many cities. When persistent, these factors have continued to further imperil the public health and wellbeing of neighborhoods and have increased the social and psychological costs of the pandemic. Our cities are in grave peril.

### **Strategic Implications – What role would agriculture and food play in potential future war?**

Starting in May 2019, a series of five articles entitled "Food and Agriculture are Domains of War (Parts 1-5)" was published in Food Safety Magazine.<sup>3</sup> In the first of the series, it was posited, "In future global conflicts, agriculture and the food supply will be targets of our adversaries. Both government and industry need a detailed and informed inventory of potential future threats to food and agriculture. Both constituencies should share the lists, carefully compare and contrast results, and, most importantly, ask why they are so divergent."<sup>4</sup> The basis for these claims was history. History proves almost invariably that food and water are two elements critical to victory during conflict. He who controls food, prevails. Agribusiness and government however have very divergent views of potential threats to food and agriculture.

Beyond the mandated requirements for Food Defense<sup>5</sup>, agribusiness largely considers the protection of the nation and its infrastructures as the sole responsibility of the government. Food and agriculture have only in the last two decades become aware the added responsibilities necessary to protect itself as Critical Infrastructures. These national security roles go beyond the traditionally practiced protection roles related to trade secrets,

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<sup>3</sup> Website: <https://www.foodsafetymagazine.com/>.

<sup>4</sup> Norton, R.A. (2019). "Food and Agriculture Are Domains of War: Part 1" Food Safety Magazine. Posted 21 May. Link: <https://www.foodsafetymagazine.com/enewsletter/food-and-agriculture-are-domains-of-war-part-1/>.

<sup>5</sup> "Food Defense is the effort to protect food from acts of intentional adulteration". In May 2016 FDA issued the final rule on mitigation strategies to protect food against intentional adulteration with requirements for food defense plans. Source: <https://www.fda.gov/food/food-defense>. "The FDA Food Safety Modernization Act (FSMA) final rule is aimed at preventing intentional adulteration from acts intended to cause wide-scale harm to public health, including acts of terrorism targeting the food supply. Such acts, while not likely to occur, could cause illness, death, economic disruption of the food supply absent mitigation strategies." Link: <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-mitigation-strategies-protect-food-against-intentional-adulteration>.

formulas/recipes and other intellectual property, but are still not universally accepted across the domains. Food and agriculture are Critical Infrastructures, but collectively often don't posture themselves as the ultimate source of the food supply. This strategic perspective disparity extends deep into the federal bureaucracy. Enforcing the regulations related to food production and processing is very different from creating the food supply. Discontinuity in the defense stance between government and business creates compounded risk, thus also new vulnerabilities. Although, national security related Intelligence authorities are clearly the sole purview of the federal government, "Government...knows nothing about how the food industry works and how to put a food product on consumers' tables. At the same time, industry knows nothing about the real threats and cannot adequately prepare."<sup>6</sup> The two domains continue to talk past one another. COVID made the communication channels even more problematic.

## **A War Game for Agribusiness**

The Food Safety Magazine series focused on a hypothetical "conflict" between the U.S. and China, defining it as "...a violent military clash between the U.S. and its allies and one of the "near peer" (i.e., China and Russia) or lower tier (Iran and North Korea) nations."<sup>7</sup> In the scenario presented, China invades Taiwan and because we are allies with that island nation, we too are confronted, but in a different way. China seeks to keep us from fully engaging in Taiwan's defense by creating asymmetric advantage through targeting U.S. Critical Infrastructures (CIs). The series of articles was designed to encourage creation of a "War Game" or mental exercise about agribusiness's potential response to crisis. The first in the series explained, "This is a hypothetical designed to make you think about your company, its assets, its people, and your brand should something very bad happen in the world...(S)hould the nation one day go to war, you and your company will be on the front lines."<sup>8</sup>

The first article introduced the concepts associated with "cascading effects" and the potential damage, (primary, secondary, tertiary and beyond) that might be inflicted on food and agriculture corporations in various stages of the conflict. "(O)ne could expect attacks on the agricultural system through the introduction of disease agents—agroterrorism. Unlike natural disease outbreaks or even foreign disease outbreaks, agroterrorism likely would entail multiple pathogens, crossing animal and plant species, geographically dispersed over large portions of rural America. Assume that foreign agents are here, including those in "sleeper cells" who would spread both agroterrorism and bioterrorism agents."<sup>9</sup>

In part two of the series the issues related to cyber warfare were introduced as highly likely in a near peer conflict, but also ongoing in many guises. Stated in military terms, we are

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<sup>6</sup> Norton, R.A. (2019). "Food and Agriculture Are Domains of War: Part 1" Food Safety Magazine. Posted 21 May. Link: <https://www.foodsafetymagazine.com/enewsletter/food-and-agriculture-are-domains-of-war-part-1/>.

<sup>7</sup> IBID.

<sup>8</sup> IBID.

<sup>9</sup> IBID.

witnessing “preparation of the battlefield.” China is clearly targeting corporations through Intellectual Property (IP) theft. In a recent article FBI Director Christopher Wray indicated that China was stealing technology by “...any means necessary”, including through exploitation of college campuses. In a meeting at the Washington’s Center for Strategic and International, Wray further stated that the FBI believed, “...no country poses a greater threat than Communist China.”<sup>10</sup> Many companies understand the threat, particularly those involved in manufacturing, pharmaceutical and medical devices or cyber-related technologies, all of which have experienced an uptick of cyber attacks during COVID-19.

In terms of cyber attacks, “...both Russia and China are capable of disrupting critical national infrastructure in the United States, potentially bringing down the electric grid and crippling power companies for anywhere from “days to weeks.” This is not mere speculation, either. According to the CIA, Russia deployed similar types of cyber attacks against critical infrastructure in Ukraine in 2015 and 2016. Of particular risk, say U.S. intelligence officials, is the ability of Russia and China to target natural gas pipelines in the United States.”<sup>11</sup> Although, some might think these adversary capabilities, and perhaps more importantly US-CI vulnerabilities is tangential to food and agriculture concerns they are not.

A simple examination of the vulnerabilities provides evidence of how cascading effects from one CI to another can occur. “The Food and Agriculture Sector has critical dependencies with many sectors, but particularly with the following:

- Water and Wastewater Systems, for clean irrigation and processed water
- Transportation Systems, for movement of products and livestock
- Energy, to power the equipment needed for agriculture production and food processing
- Chemical, for fertilizers and pesticides used in the production of crops”<sup>12</sup>

From this interconnectivity, resiliency and economy are produced, but only in times of peace. Adversaries can gain asymmetric advantage, by turning a strength into a vulnerability. Using three of the four examples of connectivity given above, one can develop a hypothetical scenario, by which the connectivity itself is exploited. The entry point of the cyberattack cascades into power, then extend into water and wastewater systems, potentially causing disruption on for example the live side of animal production. As has been witnessed during COVID-19 systems disruptions can cause the food supply to be affected. This time around the disruptions were not intentional, but were certainly exacerbated by the human element – employees became ill. In actual conflict the cyber realm has the potential to cause even deeper disruptions. The lessons learned from COVID-19 have the potential of showing us

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<sup>10</sup> Source: “China theft of technology is biggest law enforcement threat to US, FBI says” The Guardian. Posted 6 February 2020. Link: <https://www.theguardian.com/world/2020/feb/06/china-technology-theft-fbi-biggest-threat>.

<sup>11</sup> Linsey, Nicole (2019). “Russia and China Can Cripple Critical Infrastructure in United States” CPO Magazine. Posted 12 February. Link: <https://www.cpomagazine.com/cyber-security/russia-and-china-can-cripple-critical-infrastructure-in-united-states/>.

<sup>12</sup> Source: Cybersecurity and Infrastructure Security Agency (CISA). “Food and Agriculture Sector”. Link: <https://www.cisa.gov/food-and-agriculture-sector>.

vulnerabilities we might otherwise have recognized. Those lessons must not be lost, as we reengage the society. They will likely be needed in the future.

## **Chinese Military Strategy – Are Food and Agriculture Targets?**

“Several elements imply potential attacks on food and agriculture, but a larger contextual analysis and deeper dive into available data are necessary to accurately discern potential agriculture and food targets, or the ways in which they could be attacked. Openly available Chinese military literature does not call for direct attacks on U.S. food and agriculture; that level of candor and specificity would be foolish on the part of the Chinese and invite immediate economic and diplomatic retaliation by the U.S.”<sup>13</sup>

Although much of the needed data necessarily remains behind the walls of security classifications, we can use publically available information to examine some of what might happen in a series of scenarios. Referring back to the hypothetical scenario of the invasion of Taiwan by China, we can assume as reasonable the full expectation that CIs would be targeted in the U.S. To back this assumption, it becomes important to better understand Chinese military doctrine.

“Over the last decade, the Chinese People’s Liberation Army (PLA) has developed a military doctrine called “Systems Confrontation and System Destruction” aimed at defeating the U.S. military.<sup>14</sup> The doctrine outlines strategies to attack our military, characterized as a highly complex, interlocking system of systems. Although we have the most highly trained, equipped, and experienced military personnel in the world, our battlefield dominance is dependent on technology such as satellite systems that play a crucial role in detecting enemy movement as well as enabling communication and precision targeting. We are also highly dependent on our logistics capabilities to project power to any location in the world.”<sup>15</sup>

A RAND report written in 2018 further illuminates the doctrinal developments of China.

“The People’s Liberation Army’s (PLA’s) approach to training, organizing, and equipping for modern warfare over the past two decades has been thoroughly influenced by systems thinking. Indeed, modern military conflict is perceived by the PLA to be a confrontation between opposing systems, or what are specifically referred to as opposing operational systems [作战体系].”<sup>16</sup>

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<sup>13</sup> IBID.

<sup>14</sup> Engstrom, Jeffrey (2018). “Systems Confrontation and System Destruction – How the Chinese People’s Liberation Army Seeks to Wage Modern Warfare”. RAND Corporation. Link:

[https://www.rand.org/content/dam/rand/pubs/research\\_reports/RR1700/RR1708/RAND\\_RR1708.pdf](https://www.rand.org/content/dam/rand/pubs/research_reports/RR1700/RR1708/RAND_RR1708.pdf).

<sup>15</sup> Norton, R.A. (2019). “Food and Agriculture are Domains of War: Part 4.” Food Safety Magazine. 6 August. Link:

<https://www.foodsafetymagazine.com/enewsletter/food-and-agriculture-are-domains-of-war-part-4/>.

<sup>16</sup> Engstrom, Jeffrey (2018). “Systems Confrontation and System Destruction – How the Chinese People’s Liberation Army Seeks to Wage Modern Warfare”. RAND Corporation. Link:

[https://www.rand.org/content/dam/rand/pubs/research\\_reports/RR1700/RR1708/RAND\\_RR1708.pdf](https://www.rand.org/content/dam/rand/pubs/research_reports/RR1700/RR1708/RAND_RR1708.pdf).

The report also makes a startling revelation. "So far...these topics have received meager attention in the China-watching community in the West..." and includes the footnote, "To date, studies of PLA war-fighting concepts have focused mostly on campaigns. This is an important area of study but overlooks how the PLA plans to prosecute those campaigns."<sup>17</sup>

In essence, the RAND report makes the claim that both our military and government are ignoring the kind of war that China is declaring it will prosecute. Assuming that to be true - the report makes a good case that it is, one must ask the uncomfortable question on how much less are food and agriculture prepared for facing the threat possibilities if in conflict with the U.S.?

If neither the government/military nor agribusiness understand what could potentially happen in future war, it seems highly unlikely that they will develop the appropriate strategic and tactical responses (military and business) necessary to prevail in the face of an intractable enemy. Given the *probabilis res bellica*, it is highly likely that the destruction of the food supply would be prioritized for destruction by China.

If realized, this scenario would result in a very different kind and depth of disruptions experienced during COVID-19, since they would be intentional and therefore, simultaneous and designed to overwhelm.

"(S)ystems confrontation is waged not only in the traditional physical domains of land, sea, and air, but also in outer space, cyberspace, electromagnetic, and even psychological domains. "Psychological warfare," or "PSYOPS," is designed to help break the will of the enemy (that would be us in this case).

Psychological operations do not end on the battlefield... In an effort to encourage surrender, nation states like China would seek to sow doubts about the government's ability to protect its citizens and to foment dissent. The PLA is developing the capabilities to cause disruption of critical infrastructures (cyber, power grid, etc.); disruption would cascade into the agriculture, food, and water sectors. Perception always trumps reality in successful PSYOPS. Disruption occurs when the American public believes there is a contaminated food supply, whether that contamination has actually occurred."<sup>18</sup>

Major disruptions in the logistical systems are also expected in time of war. These too would be on a different scale from those that accompanied COVID-19.

"Food and agriculture corporations should anticipate other tactics, including indirect attacks like disabling the satellite system used to enable land navigation. Imagine the chaos resulting from the loss of GPS or other logistics support systems. GPS loss would not be fatal, but would be disruptive and

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<sup>17</sup> IBID.

<sup>18</sup> Norton, R.A. (2019). "Food and Agriculture are Domains of War: Part 4." Food Safety Magazine. 6 August. Link: <https://www.foodsafetymagazine.com/enewsletter/food-and-agriculture-are-domains-of-war-part-4/>.

expensive. Imagine the cost and inconvenience of having to locate maps to reestablish food delivery operations. And how can you know which products to deliver to what customers if you have lost your customer listings and their orders and no longer have GPS-facilitated navigation capabilities?"<sup>19</sup>

The military food and civilian food supply are one and the same in the United States. They will be treated as such by adversaries. "The PLA<sup>20</sup>, like the U.S. military, prioritizes the "military supplies and resources provision support network."<sup>21</sup> Armies have to eat, and hungry armies are less capable of sustaining the fight."<sup>22</sup> Beyond the PLA, the Chinese have also developed asymmetric warfare techniques, tactics and procedures (TTPs) that are specifically designed exploit the seams of U.S. military doctrine, U.S. Titles and Authorities, as well as interagency protocols. This phenomenon is called "Gray Zone" warfare and the Chinese are by far the most advanced at employing these asymmetric methods. Not only could the Chinese employ cyber capabilities to disrupt U.S. logistics infrastructure and supply chains in conus, they can also severely affect regional supply hubs and critical shipping in the INDO-PACOM theatre without firing a shot.

One primary example of such capability is China's armed fishing militia, officially called the People's Armed Forces Maritime Militia (PAFMM) by the U.S. Department of Defense plays a particularly important role in establishing an asymmetric Chinese operating presence in disputed areas in effect, changing at sea, to challenge naval forces ability to re-supply carrier battle groups via underway replenishment. These classic "gray zone" operations are designed to "win without fighting" by overwhelming the adversary with swarms of fishing vessels usually bolstered from the rear together with CCG, and possibly PLAN ships, depending on the contingency. The only estimate of the size of the Maritime Militia obtained during the course of this research was from a source published in 1978, which put the number of personnel at 750,000 on approximately 140,000 craft.<sup>23</sup> If fully mobilized such forces could cause significant disruptions to maritime based logistics and not only impact U.S. capabilities but also impact global economic and logistics networks if need be.

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<sup>19</sup> IBID.

<sup>20</sup> The Peoples Liberation Army (PLA) is the armed forces of China (People's Republic of China; PRC) founded and ruled by the Communist Party of China (CPC).

<sup>21</sup> Engstrom, Jeffrey (2018). "Systems Confrontation and System Destruction – How the Chinese People's Liberation Army Seeks to Wage Modern Warfare". RAND Corporation. Link: [https://www.rand.org/content/dam/rand/pubs/research\\_reports/RR1700/RR1708/RAND\\_RR1708.pdf](https://www.rand.org/content/dam/rand/pubs/research_reports/RR1700/RR1708/RAND_RR1708.pdf).

<sup>22</sup> Norton, R.A. (2019). "Food and Agriculture are Domains of War: Part 4." Food Safety Magazine. 6 August. Link: <https://www.foodsafetymagazine.com/enewsletter/food-and-agriculture-are-domains-of-war-part-4/>.

<sup>23</sup> Stephen Uhalley, "China in the Pacific," Oceans (May 1978), p. 33; op. cit. David G. Muller, Jr., China as a Maritime Power (Boulder, CO: Westview Press, 1983), p. 90.

## Intelligence Community Issues

Gathering Intelligence on potential attacks on the United States is the responsibility of the Intelligence Community<sup>24</sup>. "The Intelligence Community's mission is to collect, analyze, and deliver foreign intelligence and counterintelligence information to America's leaders so they can make sound decisions to protect our country."<sup>25</sup> Although, there is no single unit that focuses solely on food and agriculture, any of the seventeen U.S. Intelligence Community (IC) member agencies are capable and regularly do gather Intelligence that would be relevant to the domain. Contact between agribusiness and the IC currently occurs via the Federal Bureau of Investigation (FBI), who could, if legally allowed, share specific direct threat information, such as a known threat to an individual company or individual. More generalized threat related information is also on occasion offered by the FBI through podcasts<sup>26</sup>, or through the Homeland Security Information Network (HSIN).<sup>27</sup>

Information sharing is best when practiced as a two-way street. "The private sector has progressively developed a wide range of intelligence capabilities spanning the entire intelligence cycle of requirements, collection, analysis, and dissemination. These capabilities may be found in a variety of business structures, including individual companies with internal intelligence units, companies specializing in providing intelligence service and products to others, and associations of security professionals. Some of these capabilities may duplicate similar ones in the Federal Intelligence Community – often because companies are not receiving the information they need from Federal sources. Additionally, however, the private sector has unique capabilities. These include providing privately held information that is not

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<sup>24</sup> "The U.S. Intelligence Community is composed of the following 17 organizations:

Two independent agencies—the Office of the Director of National Intelligence (ODNI) and the Central Intelligence Agency (CIA);

Eight Department of Defense elements—the Defense Intelligence Agency (DIA), the National Security Agency (NSA), the National Geospatial- Intelligence Agency (NGA), the National Reconnaissance Office (NRO), and intelligence elements of the four DoD services; the Army, Navy, Marine Corps, and Air Force.

Seven elements of other departments and agencies—the Department of Energy's Office of Intelligence and Counter-Intelligence; the Department of Homeland Security's Office of Intelligence and Analysis and U.S. Coast Guard Intelligence; the Department of Justice's Federal Bureau of Investigation and the Drug Enforcement Agency's Office of National Security Intelligence; the Department of State's Bureau of Intelligence and Research; and the Department of the Treasury's Office of Intelligence and Analysis." Source: <https://www.dni.gov/index.php/what-we-do/members-of-the-ic>

<sup>25</sup>Source: <https://www.intelligence.gov/mission>

<sup>26</sup> FBI (2014). Preventing Agroterrorism. Posted 12 September. Link: <https://www.fbi.gov/audio-repository/news-podcasts-thisweek-preventing-agroterrorism.mp3/view>; FBI (2008). Agroterrorism 2008 – I Posted 16 May. Link: <https://www.fbi.gov/audio-repository/news-podcasts-thisweek-agroterrorism-2008-i.mp3/view>; FBI (2008). Agroterrorism 2008 – II. Link: <https://www.fbi.gov/audio-repository/news-podcasts-thisweek-agroterrorism-2008-ii.mp3/view>.

<sup>27</sup> "The Homeland Security Information Network (HSIN) is the Department of Homeland Security's official system for trusted sharing of Sensitive but Unclassified information between federal, state, local, territorial, tribal, international and private sector partners. Mission operators use HSIN to access Homeland Security data, send requests securely between agencies, manage operations, coordinate planned event safety and security, respond to incidents, and share the information they need to fulfill their missions and help keep their communities safe." Source: <https://www.dhs.gov/homeland-security-information-network-hsin>. For more information on joining HSIN go to: <https://www.dhs.gov/how-join-hsin>.

in the public domain and providing context for information that might otherwise be missed or under-valued by the Federal Intelligence Community.”<sup>28</sup>

Ideally, the food and agriculture sectors would have an Information Sharing and Analysis Center (ISAC)<sup>29</sup> or an Information Sharing and Analysis Organization (ISAO)<sup>30</sup>, both of which are coordinated through the Cyber Security and Infrastructure Security Agency (CISA)<sup>31</sup>. Unfortunately, neither food nor agriculture to date have either an ISAC or ISAO.

ISAC and ISAOs also help circumvent the frictions that are frequently encountered when regulatory agencies become directly engaged in the information sharing process, rather than through ISACs and ISAOs. In these circumstances information sharing by industry often slows to a trickle or even stops, usually motivated by fear that the information shared will be used by the regulatory arms the agencies. A senior vice president in one of the top tier global food corporations characterized the industry perceived problem succinctly. “We don’t talk to the [government agency redacted], our lawyers do.”<sup>32</sup> Although this approach insulates the company, it impedes information flow to the government, as well other companies, both undesirable in times of disruption and challenge.

Beyond the peril, trust building is impeded. Contrary to what most of the public believes, the IC is not all seeing, all knowing. The amount of data that is gathered by the IC is almost incomprehensible. Vast amounts of the “raw intelligence” are never analyzed for a wide variety of reasons, volume being the most prominent cause. Beyond that, there is a serious gap in available subject matter experts (SMEs), capable of making sense of the data. Although, federal agencies may in the best of circumstances have a limited number of experienced analysts and perhaps even SMEs, collection efforts are often incomplete, creating data gaps that can’t be fixed without additional requirements and capabilities. Given the paucity of expertise, the disruptions of COVID-19 made the situation worse, when personnel were sent home to work remotely, largely cutting them off from classified systems. Agribusiness could also provide another lens, an “alternative view” for sense making, with government gathered raw Intelligence, but cannot do so, because there is no mechanism for sharing data.

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<sup>28</sup> National Infrastructure Advisory Council (2012). Intelligence Information Sharing - Final Report and Recommendations. Released 10 January 2012. Available online at: <https://www.dhs.gov/xlibrary/assets/niac/niac-intelligence-information-sharing-final-report-01102012.pdf>.

<sup>29</sup> “Sector-specific Information Sharing and Analysis Centers (ISACs) are non-profit, member-driven organizations formed by critical infrastructure owners and operators to share information between government and industry.” Source: <https://www.cisa.gov/information-sharing-and-awareness>.

<sup>30</sup> “Like Information Sharing and Analysis Centers (ISACs), the purpose of Information Sharing and Analysis Organizations (ISAOs) is to gather, analyze, and disseminate cyber threat information, but unlike ISACs, ISAOs are not sector-affiliated. Executive Order 13691 – Promoting Private Sector Cybersecurity Information Sharing calls for the development of ISAOs in order to promote better cybersecurity information sharing between the private sector and government, and enhance collaboration and information sharing amongst the private sector.” Source: <https://www.cisa.gov/information-sharing-and-awareness>.

<sup>31</sup> Cybersecurity and Infrastructure Security Agency (CISA) Website: <https://www.cisa.gov>.

<sup>32</sup> R.A. Norton. Personal Communication.

## Agribusiness Lessons

What then can we learn from this pandemic? First, as has been repeated throughout the series food and agriculture are essential to the welfare and economy of the U.S. and therefore are rightly considered critical infrastructures. In the midst of COVID-19 related chaos, clear heads and steady voices began to be heard. Terms like “system of systems”, “systems of systems” and “cascading events” started to be included in many discussions and in the industry press. What became apparent was solutions are possible. The first requirement in finding solutions was to better understand the exact nature of the problems being encountered.

“Disruptions in supply chains can cause severe economic losses to individual businesses and impact customer and supplier ecosystems within the wider global supply chain. Although some companies have robust business-disruption plans in place, when a disruptive event occurs, they may not detect it quickly and may forget to execute the plan. Moreover, they likely had not trained staff in simulation exercises on how to discover the events and how to implement business recovery planning. Rapid discovery of the event is crucial for the recovery process to start.”<sup>33</sup>

Decision makers during the early stages of the pandemic often acted upon incomplete and sometimes wrong information, a not uncommon feature associated with any emergency event. Since far worse disruptions can be anticipated, should global conflict ever occur, it is important that decision makers discover now how they might obtain better (i.e. more accurate) and faster insight. Careful consideration is therefore needed now on how to develop better policies and test assumptions, prior to the need for their execution in actual operations. Mistakes will always compound in times of crisis, thereby causing delirious effects to cascade. On the other hand, right and properly administered policies can slow or even stop cascading effects during crisis.

“When it comes to systems thinking, simple rules can produce complex behaviors, as represented in nature. This means that something as simple as a policy within a small company can cause myriad issues with unintended consequences. The trickle-down repercussions could potentially be unknown to the individuals making the policy. Moreover, the individuals at the operational level may be affected in ways that the policy makers didn’t think possible. This situation often happens within organizations. It could be remedied simply by communicating intentions to the right individuals within the organization.”<sup>34</sup>

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<sup>33</sup> Keogh, J.G. Keogh and C.J. Unis (2020). “Rethinking Future Food Chains: Systems Thinking and the Cascading Consequences of System Failures”. Food Safety Magazine. June/July 2020. Link: <https://www.foodsafetymagazine.com/magazine-archive1/junejuly-2020/rethinking-future-food-chains-systems-thinking-and-the-cascading-consequences-of-system-failures/>

<sup>34</sup>Keogh, J.G. Keogh and C.J. Unis (2020). “Rethinking Future Food Chains: Systems Thinking and the Cascading Consequences of System Failures”. Food Safety Magazine. June/July 2020. Link: <https://www.foodsafetymagazine.com/magazine-archive1/junejuly-2020/rethinking-future-food-chains-systems-thinking-and-the-cascading-consequences-of-system-failures/>.

The take home lesson of thinking in terms of systems, whether it be a food processing plant or the entire agriculture and food CI is that everything is connected. Decision makers therefore need to address the micro level, but also think more holistically.

“Systems thinking creates an opportunity to develop resilient systems architecture within an enterprise system. Cascading failures denote failures within systems. Changing the way we view these problems allows us to create resilient systems architecture for positive cascading implications within an enterprise system that could potentially allow for buffer zones, so that a system could be designed to fail at the first or second node rather than fail completely. This would allow other opportunities for discussion to devise a better system design for the enterprise.”<sup>35</sup>

## **China Threats to U.S. Business**

The United States faces Herculean tasks, in order for the nation to continue to compete in the global economy. The full spectrum of strategies and tactics being used by China against U.S. and global business is beyond the scope of this paper and therefore only generalizations will be made.

“Rooting out theft could prove impossible. Beijing typically doesn't dispatch spies on missions of commercial espionage. Rather, it encourages Chinese who study and work abroad to copy or steal technology and rewards them when they do. So U.S. companies might have no reason to suspect anything — until a Chinese employee leaves and the employer discovers that trade secrets have been compromised.

Most U.S. companies are reluctant to voice specific complaints about their encounters in China. Rather, most choose to speak through trade groups to avoid retribution from Chinese regulators. Last year, for example, the European Union Chamber of Commerce in China found that 1 in 5 foreign companies says it feels compelled to transfer technology to the Chinese as the price of market access.”<sup>36</sup>

Significant targeting activity by China for COVID-19 related research has been noted by the U.S. Government since almost immediately after the outbreak first entered the global stage to become a pandemic.

“The Federal Bureau of Investigation (FBI) and the Cybersecurity and Infrastructure Security Agency (CISA) issued a public service announcement...warning organizations researching COVID-19 of likely targeting and network compromise by the People's Republic of China (PRC). Health care, pharmaceutical, and research sectors working on

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<sup>35</sup> IBID.

<sup>36</sup> Wiseman, P. and M. Liedtke, (2019). “Here are 5 cases where the U.S. says Chinese companies and workers stole American trade secrets”. Chicago Tribune. Posted 21 February. Link: <https://www.chicagotribune.com/business/ct-biz-us-china-trade-war-ip-theft-20190221-story.html>.

COVID-19 response should all be aware they are the prime targets of this activity and take the necessary steps to protect their systems.”<sup>37</sup>

Agriculture and food related enterprises are targeted in the same manner as other CIs on other non-COVID-19 related information, through “PRC-affiliated cyber actors” and “non-traditional collectors”<sup>38</sup>. Work at home strategies, used by many companies, have created increased risks during COVID-19.

“Fear of the coronavirus is causing many employers to permit—or in some cases mandate—employees to work remotely. While this measure is designed to minimize the risk of virus transmission, it presents an altogether different risk when it comes to protecting trade secrets, as employees have ripe opportunities to remove trade secrets and other sensitive information from company systems and databases. While remote access is ostensibly provided so that employees can perform their job functions from home, and may even be a necessity in that regard, some employees may take the opportunity to exploit the situation to more nefarious ends, and others may just be careless, which can lead to equally bad outcomes. In addition, employees’ external home networks may not have robust security on par with in-office network security.”<sup>39</sup>

## Poultry Processing

With the continued increase in poultry meat production, availability of labor and employee turnover have been particularly challenging. Over the course of the past 70 years procedures for poultry meat processing have continued to advance and progress towards automated

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<sup>37</sup> FBI (2020). 13 May Press Release: “FBI and CISA Warn Against Chinese Targeting of COVID-19 Research Organizations”. Link: <https://www.fbi.gov/news/pressrel/press-releases/fbi-and-cisa-warn-against-chinese-targeting-of-covid-19-research-organizations>.

<sup>38</sup> The U.S. IC uses the term “non-traditional collectors” to denote among others, Chinese students and researchers, which may seek to enter the U.S. through an affiliation to a college, university or business (e.g. student intern) for the purpose of collecting IP and trade secrets. A recent Whitehouse Proclamation made on 29 May 2020 specifically noted,

“The People’s Republic of China (PRC) is engaged in a wide-ranging and heavily resourced campaign to acquire sensitive United States technologies and intellectual property, in part to bolster the modernization and capability of its military, the People’s Liberation Army (PLA). The PRC’s acquisition of sensitive United States technologies and intellectual property to modernize its military is a threat to our Nation’s long-term economic vitality and the safety and security of the American people.

The PRC authorities use some Chinese students, mostly post-graduate students and post-doctorate researchers, to operate as non-traditional collectors of intellectual property. Thus, students or researchers from the PRC studying or researching beyond the undergraduate level who are or have been associated with the PLA are at high risk of being exploited or co-opted by the PRC authorities and provide particular cause for concern. In light of the above, I have determined that the entry of certain nationals of the PRC seeking to enter the United States pursuant to an F or J visa to study or conduct research in the United States would be detrimental to the interests of the United States.” Source: <https://www.whitehouse.gov/presidential-actions/proclamation-suspension-entry-nonimmigrants-certain-students-researchers-peoples-republic-china/>.

<sup>39</sup> Weibust, E. M. Mintz and J. Cohen (2020). “Love in the Time of Coronavirus: Protecting Trade Secrets During a Pandemic”. Trading Secrets – A Law Blog on Trade Secrets, Non-Competes, and Computer Fraud. Posted 5 March. Link: <https://www.tradesecretslaw.com/2020/03/articles/trade-secrets/love-in-the-time-of-coronavirus-protecting-trade-secrets-during-a-pandemic/>

systems. Automation has allowed processors to improve efficiency increasing line speeds up to 13,000 birds per hour while maintaining or improving product safety.

Deboning lines oftentimes remain as a labor intensive part of the process. Over the course of the past twenty years millions of dollars have been invested in research and development of systems for automated carcass deboning. However, these automated deboning systems will lead to lower yields than a skilled employee. Automated vs manual product yields have been improving each year with technological advancements in engineering and intelligent robotics. Continued movement towards automation can minimize the number of employees required to complete the process, but skilled people will also be necessary to oversee and maintain these automated systems. Proprietary information (setting, speeds, etc.), as well as control software for those systems is of immense financial value and therefore a prime target for theft by China, which seeks to gain market advantage, without investment.

COVID-19 has caused the current rate of employee absenteeism to increase, necessitating food processing with fewer hands. This change is expected to further drive discussions, begun pre-pandemic, on whether investment in wholly automated deboning systems can now be justified, given the economy borne from the use of human workers has been lost, due to COVID-19 related absenteeism. Given further that the return on investment is not yet clear, some companies may choose to invest in automated systems now to alleviate ongoing labor issues, while others may wait to see if those problems persist longer term, perhaps post vaccination.

As plant testing of team members for COVID-19 has occurred, results from employee testing has also caused greater worker absenteeism out of health concerns outside the production and manufacturing arena. Food processing plant personnel frequently live multigenerational homes. In some instances, all family members work in the processing plant (Production A, Production B, or Sanitation), or alternatively work in other labor intensive, high-volume employee fields of agriculture. Although definitive data is not yet available, whatever the field of agribusiness employment, it appears likely that a high percentage of COVID cases within meat production facilities may be due to community exposure, such as might occur when workers return home. Interestingly, the number of cases reported within other food production facilities (e.g. dairies) does not appear to impact these industries as quickly and severely, when compared to the meat industry.

While it is not impossible for COVID-19 to originate at the plant level, it appears most likely the result of lessened social distancing and perhaps failure to remain masked that may occur during shift changes, within the lunch and break areas, and inside the locker rooms that house several hundred workers for extended periods of time. Within the red meat industry (beef, pork, lamb and goat), automation is extremely limited and unlikely to be widely adopted in the next ten years. In some steps of processing, automation does exist for pork, lamb and goat due to uniformity of animal shape and size. Efforts in some countries have focused on automating hide and pelt removal of sheep and goats. In the pork industry,

carcass splitting during harvest steps is currently used. However, for the beef industry there remains a large void of automated use in the United States largely due to the variation in animal shape and size. Other proteins such as turkey, chicken, pork, goat and sheep have streamlined the live animal production phases to create a more uniform animal. Improved genetics for growth and carcass characteristics have been adopted allowing for automation to be utilized. Adoption of automation on a large scale within the United States has been often limited to areas where repeated steps within a uniform setting can be achieved.

Boxing, packaging, mixing, blending, batching, slicing, weighing, palletizing of manufactured value-added products is the major focus of automation within the meat industry today. Automation of additional steps during the harvest and fabrication process of all red meat animal proteins would be greatly beneficial. Automation would allow for production operations to remain intact during worker shortages such as witnessed throughout the COVID-19 pandemic. While the meat industry remains focused and driven by a worker-based production method, automating and robotic adoption of segments is quite plausible. Each protein has a unique fabrication style for generating boxed meat proteins for use throughout the meat industry arenas. Adopting automation within these various meat protein business units is the ultimate hurdle that must be addressed. Fabricating a pork carcass is not the same as cutting a beef carcass or a lamb or even a chicken. Each carcass presents unique muscles locations, bones and marketing streams within their respective protein business units that creates difficulty in the identification of robotic systems.

## **Presidential order and the Defense Production Act (DPA) Authorities**

On 28 April 2020, President Donald Trump signed, "Executive Order on Delegating Authority Under the DPA with Respect to Food Supply Chain Resources During the National Emergency Caused by the Outbreak of COVID-19"<sup>40</sup>, citing authorities based on, "...the Defense Production Act of 1950, as amended (50 U.S.C. 4501 et seq.) (the "Act"), and section 301 of title 3, United States Code."<sup>41,42</sup>

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<sup>40</sup> Source: Executive Order on Delegating Authority Under the DPA with Respect to Food Supply Chain Resources During the National Emergency Caused by the Outbreak of COVID-19. Link: <https://www.whitehouse.gov/presidential-actions/executive-order-delegating-authority-dpa-respect-food-supply-chain-resources-national-emergency-caused-outbreak-covid-19/>.

<sup>41</sup> IBID.

<sup>42</sup> The EO further clarified the authorities stating,

"Accordingly, I find that meat and poultry in the food supply chain meet the criteria specified in section 101(b) of the Act (50 U.S.C. 4511(b)). Under the delegation of authority provided in this order, the Secretary of Agriculture shall take all appropriate action under that section to ensure that meat and poultry processors continue operations consistent with the guidance for their operations jointly issued by the CDC and OSHA. Under the delegation of authority provided in this order, the Secretary of Agriculture may identify additional specific food supply chain resources that meet the criteria of section 101(b).

Sec. 2. Ensuring the Continued Supply of Meat and Poultry. (a) Notwithstanding Executive Order 13603 of March 16, 2012 (National Defense Resources Preparedness), the authority of the President to require performance of contracts or orders (other than contracts of employment) to promote the national defense over performance of any other contracts or orders, to allocate materials, services, and facilities as deemed necessary or appropriate to promote the national defense, and to implement the Act in subchapter III of

The justification framing the Executive Order (EO) was that,

“Such closures threaten the continued functioning of the national meat and poultry supply chain, undermining critical infrastructure during the national emergency. Given the high volume of meat and poultry processed by many facilities, any unnecessary closures can quickly have a large effect on the food supply chain. For example, closure of a single large beef processing facility can result in the loss of over 10 million individual servings of beef in a single day. Similarly, under established supply chains, closure of a single meat or poultry processing facility can severely disrupt the supply of protein to an entire grocery store chain.”

The Secretary of Agriculture responded to the order through a press statement, which read in part, “Maintaining the health and safety of these heroic employees in order to ensure that these critical facilities can continue operating is paramount. I also want to thank the companies who are doing their best to keep their workforce safe as well as keeping our food supply sustained. USDA will continue to work with its partners across the federal government to ensure employee safety to maintain this essential industry.”<sup>43</sup>

The application of an EO based on DPA was certainly unprecedented in this century, its application to the food industry was not designed to force sick people back to work, but rather to assist the companies in prioritizing and acquiring quick fix solutions, and to provide access to the national stockpiles (gloves, masks, etc.). In this way the EO prioritized worker safety, but also sought to better prevent further disruption of the food supply.

Orders based on DPA include several relevant provisions that positively impacted agriculture and food:

“Title I: Priorities and Allocations, which allows the President to require persons (including businesses and corporations) to (1) prioritize and accept government contracts for materials and services, and (2) **allocate or control the general distribution of materials, services,**

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chapter 55 of title 50, United States Code (50 U.S.C. 4554, 4555, 4556, 4559, 4560), is delegated to the Secretary of Agriculture with respect to food supply chain resources, including meat and poultry, during the national emergency caused by the outbreak of COVID-19 within the United States.

(b) Secretary of Agriculture shall use the authority under section 101 of the Act, in consultation with the heads of such other executive departments and agencies as he deems appropriate, to determine the proper nationwide priorities and allocation of all the materials, services, and facilities necessary to ensure the continued supply of meat and poultry, consistent with the guidance for the operations of meat and poultry processing facilities jointly issued by the CDC and OSHA.” Source: <https://www.whitehouse.gov/presidential-actions/executive-order-delegating-authority-dpa-respect-food-supply-chain-resources-national-emergency-caused-outbreak-covid-19/>.

<sup>43</sup> Source: USDA To Implement President Trump’s Executive Order On Meat and Poultry Processors. Posted 28 April 2020. Link: <https://www.usda.gov/media/press-releases/2020/04/28/usda-implement-president-trumps-executive-order-meat-and-poultry>.

**and facilities as necessary to promote the national defense.** Title I prioritization authorities are regularly utilized by the Department of Defense (DOD) to acquire critical military capabilities and less frequently by the Department of Homeland Security (DHS) for disaster response and preparedness needs.”

Title III: Expansion of Productive Capacity and Supply, which allows the President to provide economic incentives to secure domestic industrial capabilities essential to meet national defense and homeland security requirements. DPA Title III is specifically intended to “create, maintain, protect, expand, or restore domestic industrial base capabilities” (50 U.S.C. §4533). **Authorized incentives include loans, loan guarantees, direct purchases and purchase commitments, and the authority to procure and install equipment in private industrial facilities.**

Title VII: General Provisions, which includes key definitions and other distinct authorities. These provisions grant the President the authority to establish voluntary agreements with private industry; **the authority to block proposed or pending foreign corporate mergers, acquisitions, or takeovers that threaten national security; and the authority to employ persons of outstanding experience and ability and to establish a volunteer pool of industry executives who could be called to government service in the interest of the national defense.**”<sup>44</sup> (emphasis added)

Although, there is no direct evidence of collaboration, the timing of the EO to the publication of the letter by John Tyson, CEO of Tyson Foods on 26 April 2020 was, if nothing else, a remarkable coincidence, particularly given that EOs take time because of legal review. Tyson framed the scope of the problem well.

“Tyson Foods has a responsibility to feed our nation and the world. The government bodies at the national, state, county and city levels must unite in a comprehensive, thoughtful and productive way to allow our team members to work in safety without fear, panic or worry. The private and public sectors must come together. As a country, this is our time to show the world what we can do when working together.

In addition to meat shortages, this is a serious food waste issue. Farmers across the nation simply will not have anywhere to sell their livestock to be processed, when they could have fed the nation. Millions of animals

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<sup>44</sup> Congressional Research Service (2020). The Defense Production Act (DPA) and COVID-19: Key Authorities and Policy Considerations. Updated March 18, 2020. Link: <https://fas.org/sgp/crs/natsec/IN11231.pdf>.

– chickens, pigs and cattle – will be depopulated because of the closure of our processing facilities. The food supply chain is breaking.”<sup>45</sup>

The President’s EO in turn designated,

“...meat and poultry in the food supply chain” as “critical and strategic materials” under section 101(b) of the DPA. This section of the DPA permits the President to control distribution of designated materials in the civilian market, if: (1) the material is determined to be essential to the national defense, and (2) that the requirements of the national defense cannot be met through other means “without creating a significant dislocation of the normal distribution” of the designated material “to such a degree as to create appreciable hardship.” Having made such a finding, the EO authorizes the Secretary of Agriculture to “take all appropriate action under [section 101(b)] to ensure that meat and poultry processors continue operations consistent with the guidance for their operations jointly issued by the [Centers for Disease Control and Prevention (CDC)] and [the Occupational Safety and Health Administration (OSHA)].” Based on a plain reading of the text, the EO itself does not order any plants to remain open. Rather, it permits the Secretary to issue regulations, orders, or take other actions to address continued operation of processors, while also ensuring that processors adhere to the CDC/OSHA guidance.

The EO further authorizes the Secretary to **“identify additional specific food supply chain resources” as “critical and strategic materials”** under the DPA. Based on this authorization, the Secretary could conceivably extend the reach of the EO beyond meat and poultry to any other commodity or resource within a food supply chain, provided these commodities or resources satisfy the requirements of section 101(b).

Finally, the EO provides additional authority under section 101(a) of the DPA to allow the Secretary to prioritize contracts or **“allocate materials, services, and facilities as deemed necessary or appropriate to promote the national defense.”** To implement this part of the EO, the President has also delegated authority to the Secretary to, among other things, issue regulations and orders, require information or records from any person, and seek to enforce DPA orders (discussed in more detail below). The U.S. Department of Agriculture (USDA) currently has regulations, known as the Agriculture Priorities

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<sup>45</sup> Tyson, John (2020). “Feeding the Nation and Keeping Our Team Members Healthy” Posted 26 April. Link: <https://thefeed.blog/2020/04/26/feeding-the-nation-and-keeping-our-employees-healthy/>.

and Allocations System (APAS), in place to set out how it will implement section 101 during emergencies and non-emergencies, as directed by President Obama's Executive Order 13603. President Trump's new EO seeks to ensure that USDA may create new or amended regulations if USDA believes it necessary to address the COVID-19 emergency (i.e., USDA may rely on existing regulations, but could also issue new or amended regulations)."<sup>46</sup> (emphasis added)

## **Future Issues for Agriculture and the Food Supply**

Our nation's infrastructures are not as robust as we might once have thought. Although, this series concentrates on agriculture and the food supply, many of the frictions observed can be applied to other CIs. All CIs depend on people, which serve both as the strongest asset, but also the weakest link. Complex systems and larger systems of systems are made operational by people. In the strictest sense, there is no such thing as an autonomous system. If people fall ill or in some other way are impeded from doing their job, the systems they operate will degrade. Single point failures seldom stay isolated. Once a failure starts to cascade, it is often difficult to stop, potentially causing far reaching effects.

As we have seen during the COVID-19 pandemic, food is no longer a given in the United States. COVID-19 has illustrated the need for greater personal and community resilience, which begins with public health. Most major cities in the United States maintain no more than a three day food supply. That is not where communities or our nation needs to be. We are still too early in this pandemic to make any credible projections of what will occur in the future.

Regardless of the challenges, agribusiness and government will both face, collectively all have to better collaborate. The overabundance of "experts", inside and outside of government that spent inordinate amounts of time in the glare of the mainstream media must be remedied. Too little time was spent in the collection and critical analysis of fact. Error was and continues to occur frequently, its damages are compounded by its immediate insertion into social media. Solutions to these problems must be found if we are to become more resilient as a nation and an economy. Public health must become a national priority, since in its most basic form, it is the foundation of all other functions of our nation. Failure to learn from the COVID-19 mistakes, surely means we will remain unprepared for the challenges surely to come our way in the future.

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<sup>46</sup> Congressional Research Service (2020). "Executive Order on the Food Supply Chain and the Defense Production Act: FAQs". Posted 1 May. Link: <https://crsreports.congress.gov/product/pdf/LSB/LSB10456>.