Building an all-hazards agricultural emergency response system to maintain business continuity and promote the sustainable supply of food and agricultural products

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Abstract: The response to an agricultural emergency that threatens to destroy crops or animals requires a rapid, coordinated state-level response from the outset. An authority should be established at the local level to initiate and enforce food embargoes, quarantine livestock or poultry premises, depopulate affected or potentially affected animals, and provide indemnity, when appropriate, for those depopulated animals or destroyed products. Depending on the scale of the threat, industry needs, state resources, and response capacity, the authority for these activities currently resides with the state and is supported by federal agencies. However, an all-encompassing all-hazards agricultural emergency response system can be constructed through collaborations with agricultural industry, state responders, and federal agencies. The formed response should include development of

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PUBLIC Interest STATEMENT

Many farms are part of a just-in-time agricultural system where an egg laid today may be sold tomorrow. When an agricultural emergency happens, movements from all farms in an area may be stopped to prevent further disaster. Collateral damage that comes from stopping animal and food movements from farms may be a larger threat to the food supply and economic viability of rural communities than the hazard itself. This perspective article details the importance of an all-hazards response to agricultural emergencies. We describe lessons learned from past emergency responses. We propose a way to respond more effectively to all future threats by following sound scientific approaches that use public-private partnerships to allow the marketing of unaffected animals and food from a disaster area. Successfully doing so will save resources, maintain market supplies, and contribute to agricultural sustainability by reducing unnecessary destruction of healthy animals and safe food products.
permitting guidance for controlled harvest and movement of unaffected crops, animals, and animal products. The ultimate goal is to effectively manage the emergency yet maintain agricultural business continuity.

Subjects: Environment & Agriculture; Agriculture & Environmental Sciences; Agriculture; Agriculture and Food

Keywords: emergency response; emergency preparedness; agriculture; food security

1. Introduction
When there is a fire, flood, or tornado emergency in a community, there are local responders at the ready to safeguard the public. If the emergency is beyond what local Police, Fire, or Emergency Management Systems can handle, then state resources are deployed. In contrast, there is currently no established local authority to command or manage an agricultural emergency response, so a response to an agricultural emergency that threatens to destroy crops or animals is not carried out with the same level of efficiency even though it requires a rapid and coordinated response from the outset. Specifically, there is no local authority that can set up food embargoes, quarantine livestock, poultry, or other agricultural premises, depopulate or destroy affected or potentially affected crops and animals, or provide indemnity for those depopulated animals or destroyed products. Yet these are all necessary steps to take to ensure an economically and environmentally sustainable high-producing food system remains intact after the emergency is resolved. In many areas, the authority for these activities resides with the state and is supported at the national level; and the level of national support is dependent on the scale of the outbreak, state resources, and the ability of the state's agriculture agencies and producers. As of now it is conceivable that local agriculture emergency preparedness and response is not closely aligned with national or state emergency preparedness and response models. This needs to change.

2. Methods: assessing the situation
To explore how to effectively manage emergency situations via a more cohesive, multilevel, multiagency response that maintains continuity of business, the impacts of historical agricultural disasters were searched and studied to form an initial assessment of past events. Specifically, the HPAI outbreak of 2014 and 2015 was loosely assessed to observe the impacts of the current disease response and continuity of business efforts that are in place. Challenges were subjectively identified and illustrated based on the outline of hypothetical outbreak of foot-and-mouth disease in the United States. Impacts of the hypothetical outbreak were assessed via observing how known animal movements and operations would be affected and how the scale, illustrated by industry statistics, would factor into the total impact. Historical examples of other animal and food related disasters were collected from literature based on impact observed. Literature searches were completed using relevant search terms and concepts in English only. Events were included based on relevance of economic damages. Search engines and databases from on-line and print collections included Pubmed, Google Scholar, Google search engine, University of Minnesota Library Catalog, and the University of Minnesota Veterinary Medical Library.

3. Results: lessons learned from past emergency responses

3.1. 2015 highly pathogenic avian influenza outbreak: emergence, impacts, and responses
The 2015 Highly Pathogenic Avian Influenza (HPAI) outbreak was the largest, most costly animal disease response in US history. Nationally, there were 211 detections in commercial poultry operations and another 21 detections on backyard premises in 21 states. Approximately 7.4 million turkeys and 43 million egg-layers/pullet chickens died from the disease or were depopulated as part of the outbreak response. According to United States Department of Agriculture (USDA), the outbreak cost taxpayers $1 billion in indemnity, with the response and cleanup costs creating a total economic impact of $3.3 billion. In Minnesota alone, over 9,000,000
birds on 109 poultry farms were affected with an estimated economic loss of $650 million (Greene, 2015).

3.2. **Strengths and weaknesses of the 2015 response**

The 2015 HPAI outbreak highlighted both strengths and weaknesses in the nation’s and Minnesota’s ability to plan for, prepare for, and respond to agricultural emergencies. Using our experiences derived from National and State perspectives, we herein aim to identify and examine these weaknesses in order to conceptualize new strategies to address national production agriculture preparedness and response needs.

3.3. **Challenges of a foreign animal disease outbreak emergency response**

The size, structure, efficiency, complexity, extensive movement, just-in-time delivery, and dependent markets inherent to the nation’s livestock, poultry, crop, and allied production systems present unprecedented challenges in the event of a catastrophic animal or plant disease event. A foreign animal or plant disease outbreak has the ability to cripple the nation’s agricultural sector and threaten the long-term economic viability of US livestock and agriculture production.

To understand the devastation that foreign animal (or plant) disease emergency may have on US agriculture, the following information is provided as an illustration of the effects of an animal disease outbreak. Iowa, North Carolina and Minnesota are the first, second, and third ranking states in hog production accounting for nearly 55% of the nation’s swine supply (USDA NASS, 2014). North Carolina ships a majority of its feeder (young) pigs, thousands daily, to Iowa and other Midwest states where they are raised to market weight. In 2001, the Midwest received between three and four million pigs from North Carolina, alone (USDA, 2011). The scale of the industry is dependent on a continuous flow of animals across the country—and across state lines—in order to maintain efficiency. The state of Iowa receives 70,000 pigs daily as a single state example, and 625,000 pigs are being transported daily in the United States assuming slaughter plants are running on a five day a week schedule (USDA, 2011).

Now consider this devastating scenario: Foot-and-mouth disease (FMD) is confirmed in a North Carolina swine herd. This confirmation sets up the following cascade of events: A Control Area, a type of quarantine zone that requires a permit to move product in and out of, is established (USDA, 2015). Based on the species affected, animal density and other factors, the Control Area may be significantly larger than the minimum 10 km radius circle (area of 314 km$^2$) used during the 2015, 2016, or 2017 HPAI outbreaks (USDA, 2015). For the purposes of this scenario, the initial Control Area will be three counties in North Carolina. If we use an average county size in North Carolina, the area would be 2486 km$^2$. Within the Control Area there are the following premises: 1 infected swine premises, 2 contact swine premises, and 150 swine premises identified as not known to be infected and not known to have contact with the infected premises. The USDA, with industry support, calls for an immediate national product movement standstill, essentially this is a stop movement order that requires producers to not move any animals or products or, if in transit, to get to their destination and STOP! The index case herd will be depopulated. International notifications are made and all exports of cloven hooved animals (such as pigs, cattle, etc.) and corresponding animal products are prohibited, refused, or cancelled.

If the above scenario were to occur, the US swine industry estimates that producers have about three days before significant animal welfare issues would occur as a result of the standstill orders. Thus, there is an urgent need to quickly answer the following question: Will Midwest states allow North Carolina to move pigs into their state to be sold or processed? Or more specifically will the Iowa swine industry or Nebraska or South Dakota cattle industries insist states not allow North Carolina to move pigs into their states? These interstate movements occur daily. It is estimated that 71% of pigs in the United States are grown up to market weight at a different location from where they were born (USDA NASS, 2014). The pork producers in these states will be concerned that upon receiving pigs from North Carolina, pigs in the Midwest will become at risk of infection. In
addition, if the imported pigs from North Carolina are epidemiologically linked to any infected premises in North Carolina, implying that the incoming pigs may be unknowingly infected, then premises in the importing state would lose their eligibility to ship their own pork or pork products under current FMD control plans (USDA APHIS VS, 2014). Similarly, cattle associations in these states will be concerned that, upon receiving pigs from North Carolina, cattle in the Midwest will become at risk of infection from interspecies transmission of FMD. Concern of infection is valid as there is abundant evidence that pigs are the most effective shedders of airborne Foot-and-mouth disease virus (FMDv) (Alexandersen & Donaldson, 2002) and that cattle are believed to be the most sensitive species to aerosol infection (Donaldson & Alexandersen, 2002; Donaldson, Alexandersen, Sørensen, & Mikkelsen, 2001).

Historically, response strategies have focused on the immediate depopulation, disposal, and disinfection that occur on infected/contact premises in addition to providing producers with indemnification for destroyed animals. Responders aim to complete these steps as early as possible during an outbreak. Yet, there will be dozens of affected but not known to be infected premises that are quarantined and cannot move product or animals because they are geographically located within the Control Area. Current response strategies and resources are focused on the infected and other dangerous contact premises when, in reality, there are many more affected premises that will need help. In this fictional scenario, there are 150 premises that are not known to be infected in the three county Control Area in North Carolina. We can assume 50 premises will need to move pigs from their farms within a week of the diagnosis of FMD, and 30–40 of those premises will have plans to move pigs to farms out of state. Indeed, these affected premises are not known to be infected, and historically, there have not been national or state plans or resources to address their needs for business continuity during an outbreak. As we have suggested, other states and commodities will fear the consequences of movements into their states creating barriers.

3.4. A brief history of the scale and cost of animal disease related disasters

Influenza A virus has been an ever present pathogen of concern for the US poultry industry since the first reports of influenza occurred in 1924 (Swayne & Halvorson, 2003). In the 1960s, low pathogenicity avian influenza (LPAI) viruses created huge economic issues for the turkey industries in Midwestern states. Commonly introduced from wild bird reservoirs, the virus spread into the commercial industry via subsequent lateral transmission due to inadequate biosecurity practices (Bahl et al., 1979). Beginning in the 1980s, it was noticed that LPAI was well established in live bird markets on the east coast, reaching endemic levels of infection throughout area markets and source flocks. In 1983, LPAI viruses from live bird markets extended their reach into the commercial poultry industry which subsequently led to a commercial outbreak of highly pathogenic avian influenza (HPAI) encompassing Pennsylvania, New Jersey, Virginia, and Maryland that lasted well into 1984. The 1983–1984 outbreak caused a direct loss of 17 million birds (Panigrahy, Senne, & Pedersen, 2002) at a cost of $55 million ($133 million if adjusted for 2018 inflation) to producers, with eradication, indemnity, and other costs estimated at close to $120 million ($291 million if adjusted for 2018 inflation) for the federal government (Lasley, 2003).

Characterized by significant decreases in poultry productivity, acute clinical signs, rapid increases in daily mortality, and the ability to quickly spread between premises, HPAI has proven to be debilitating to the commercial poultry industry. Influenza A viruses have demonstrated the capacity for pathogenicity in human hosts as evident from outbreaks that have occurred in regions such as British Columbia, the Netherlands, and throughout Asia (WHO/GIP, 2017). While influenza A viruses, in general, are a well-known zoonotic concern, no human cases of avian influenza have been reported in the United States, but HPAI remains a cause of tremendous damage to the US poultry industry as a whole. After the 1983–1984 outbreak on the east coast, HPAI appeared briefly in 2004 on a live bird market dealer farm in Texas, and again, most infamously, in 2014–2015 throughout the Midwest and west coast, affecting the turkey and egg laying
industries. The HPAI outbreak of 2014–2015 was the largest outbreak to date, impacting more than 20 states and resulting in the loss of roughly 50 million birds at a direct cost of $1.6 billion and at a total economic impact of $3.3 billion (Greene, 2015). Table 1 details a summary of economic costs of outbreaks of HPAI.

Although lacking the public health threats of influenza viruses, the threat to animal agriculture from FMD is more substantial. FMD is caused by a virus that is capable of infecting multiple cloven hooved species such as pigs, cattle, sheep, and goats. As depicted in the previously described scenario, an FMD outbreak affects multiple industries and is taken seriously by all states. A Minnesota outbreak of FMD would devastate not just one industry, but rather three or more, with pork, beef, milk, and fiber production likely all severely impacted, if not destroyed. The Economic Assessment of FMDv Releases from the National Bio and Agro Defense analysis is part of a congressionally mandated site-specific risk assessment, which links outcomes from clouds of airborne viruses, known as plumes, and epidemiological models to risk outcomes (Dustin, Thomas, Keith, Jayson, & Sara, 2015). The study examined the economic consequences of FMD virus releases from a national disease research facility. Specifically, they investigated the economic impacts to consumers and firms, costs to the government, and disruptions to nonagricultural regional sectors. If an outbreak of FMD were to occur in the United States, the estimated costs due to the outbreak are staggering. The Economic Assessment reported that total economic loss from an FMD event range from about $16 billion to $140 billion in damages. Table 1 demonstrates real economic damage that FMD has caused in actual past outbreaks that occurred in the United Kingdom.

Finally, Exotic Newcastle Disease (END) is a viral disease that is fatal to most, if not all, species of birds, meaning an uncontrolled outbreak would cut a wide and devastating path across poultry farms, zoo collections and pet bird populations. END is another foreign animal disease of significant concern if an outbreak occurs. Table 1 summarizes economic losses due to END in the United States. Table 1 depicts the economic impacts of a few of the END outbreaks that have occurred in the United States.

| Table 1. Summary of economic impacts of outbreaks of highly pathogenic avian influenza, foot-and-mouth disease, and exotic new castle disease |
|---|---|---|
| **Highly Pathogenic Avian Influenza Outbreaks in the US** | **Economic Effects of Outbreak** | **Source** |
| 1924/1925 | Economic impact of $12.2 million (adjusted for 2007 inflation) | (Halvorson, 2009) |
| 1983/1984 | Economic impact $156 million (adjusted for 2007 inflation) with 17 million birds affected across multiple states including Pennsylvania, New Jersey, Virginia, and Maryland | (Eckroade, Silverman, & Acland, 1984; Halvorson, 2009) |
| 2014/2015 | Economic impact of $3.3 billion with 50 million birds affected across 21 states | (Greene, 2015) |
| **Foot-and-Mouth Disease Outbreaks in the UK** | **Economic Effects of Outbreak** | **Source** |
| 2001 | Economic impact $4.2 billion (£3 billion) to the public sector | (Bourn, 2002) |
| **Exotic Newcastle Disease Outbreaks in the US** | **Economic Effects of Outbreak** | **Source** |
| 1971 | Economic impact $56 million with 12 million birds affected across the state of California | (CDFA) |
| 2002/2003 | Economic cost $161 million with 3.16 million birds affected across California, Arizona, Nevada, and Texas | (CDFA) |
3.5. A brief history of the scale and cost of food security-related disasters

In addition to disease outbreaks that kill crops or sicken animals, there are other emergencies that could affect food security. These emergencies include exposure to agricultural bioterrorism attacks and environmental toxins, both of which could result in contaminated food not fit for consumption.

Bioterrorism is defined as the purposeful and malevolent introduction of pathogenic bacteria, viruses, or fungi into susceptible plants or animals or contaminating plants or food producing animals with toxins with the goal of producing economic losses, fear, and/or threatening social stability (Monke, 2007). Protecting agricultural production from bioterrorism attacks would undoubtedly require a coordinated and multilayer response. In a US Senate Agriculture Committee hearing on 13 December 2017 Senator Pat Roberts (Republican from Kansas) stated it well: “Agriculture security is a broad-reaching issue, reaching many government agencies beyond the Department of Agriculture” (Brown, 2017).

Environmental toxins include those caused by nuclear power plant malfunctions. Historically, there has been evidence of nuclear disasters affecting local agriculture industry. The following are examples of events that are typically localized with relatively small impact. However, the scale of any of these events can escalate when consumer concerns arise that negatively impact commodity markets or crop production.

In 1979, the Three Mile Island nuclear power plant malfunctioned, and while producers were concerned about effects to their livestock, no links or ailments were reported related to the released materials from the nuclear plant (Gears, Cable, Jaroslow, & Smith, 1980). Nevertheless, out of an abundance of caution, the Pennsylvania Department of Health issued a halt on the regional drinking of milk although there was no science supporting the idea that milk was contaminated. The contamination declaration transitioned from “probably contaminated” to “may be contaminated” and finally to “doesn’t seem to be contaminated, but we’ll keep testing.” These labels briefly economically hurt the dairy industry (Sandman, 2009). During the event, grocery stores in the cities of surrounding states made a point to advertise that the milk they were selling did not originate from Pennsylvania, safeguarding their businesses from any potential profit loss. Consumer concerns and this marketing response had a great impact on the milk market. The implications of the signage meant that the event hurt the whole state of Pennsylvania and there was no recourse for counties or local areas located long distances (up to 370 km) from Three Mile Island. (Drummond Ayres, 1979). When commodity markets are affected, this shifts the scale of the impact of the hazard. Thus, a coordinated emergence response for agricultural products is greatly needed to address this increase in the scale of the hazard and corresponding response.

In 1986, the Chernobyl nuclear accident occurred while plant operators were preparing for a one-time shutdown to perform routine maintenance. In violation of safety regulations, operators disabled plant equipment including the automatic shutdown mechanisms. Extremely hot nuclear fuel rods were lowered into cooling water, an immense amount of steam was created, which created more reactivity in the nuclear core of reactor. The resultant power surge caused an immense explosion, releasing radiation into the atmosphere and cutting off the flow of coolant into the reactor, which resulted in a second even greater explosion. Nearly 52,000 km² of land used for agricultural production were directly affected (NEA OECD, 2002).

Most recently, in 2011 following a major earthquake, a 15-meter tsunami disabled the power supply and cooling of three Fukushima Daiichi reactors, causing a nuclear accident in March of that year. The disaster heavily impacted Japan’s agricultural production and devastated the Fukushima prefecture’s local agriculture industry, with 80,000 farms experiencing contamination from the nuclear disaster (PSR, 2013).
4. Discussion: future directions to address the need for a change in response

4.1. The genuine need for business continuity planning in concert with indemnification-depopulation-disposal-disinfection

History has shown that large-scale animal disease outbreak events are sporadic, making them difficult to plan and prepare for. The next large-scale outbreak could start in 30 years or this afternoon. The emergency response costs associated with the 2015 HPAI outbreaks suggest the United States cannot continue to fund response strategies based around stopping animal and animal product movement and indemnify-depopulate-dispose-disinfect all affected premises (Huffman, 2017; USDA, 2017; Weinraub, 2017). The recent 2017 Screw Worm outbreak cost in the millions of dollars to control in the wildlife and companion animal sectors alone, thus the repercussions of such a hazard entering the livestock production system would be catastrophic (Staletovich, 2017). Therefore, to manage the next large-scale agricultural emergency effectively, an all-hazards business continuity approach must be woven into agriculture emergency preparedness and response policy and strategies at the local, state, regional, and national levels. To ensure that human health and food safety are protected, there must be effective communication and collaborations between human health, animal health, and agriculture agencies. The response must be capable of implementation regardless of state or national borders because we can be certain that agricultural production and any associated emergency would also reach across state and national borders.

4.2. Business continuity—the goal of the secure food supply plans

The Secure Food System (SFS) platform including the plans for the Secure Pork Supply, Secure Milk Supply, Secure Beef Supply, and Secure Poultry Supply, are a collaborative effort utilizing a public-private partnership approach between government, industry, and academia. Partners include federal and state officials (from USDA, state boards of animal health and departments of agriculture) academic institutions (primarily University of Minnesota, Iowa State University, Kansas State University and the University of California, Davis), and production livestock/poultry industry representatives.

The goals of the plans include allowing the movement from a Control Area of animals and animal products with no evidence of infection to harvest channels or other production sites without the spread of disease or expansion of the outbreak; providing a continuous supply of safe and wholesome food to consumers; and maintaining business continuity for producers, transporters, and processors. In order to achieve this goal, products and animals within an established Control Area are moved via a permitted movement system. When used during the 2015 HPAI outbreak, the permitted movements allowed the US poultry industry to maintain close to its normal levels of production as well as contribute to the sustainability of the agricultural sector in the affected regions.

Spearheaded by the neutral party of academicians, but driven by industries at risk as well as involved regulatory parties, the SFS platform has a standard approach for the development and delivery of risk mitigation strategies for continuity of business movements. The approach involves engagement of public–private partnerships, selection of the type of product movement, and the development of a risk assessment. The public-private partnerships are essential because private industry members intimately understand how risk mitigation is realistically achievable in their industry and they understand the implications of the variability of the producers in their industries. The completed risk assessment is translated into a permit guidance (Figure 1) that is easily accessible to the public and producers and regulators that would need to use them when permitting the movement of animals during an emergency response. Table 2 is a brief summary of the successful application of the SFS platform approach during the HPAI emergency response in Minnesota. The table lists the roles and activities of each member of the partnership during that emergency response when permitting the movement of broiler hatching eggs from not known to be infected breeder farms in the disease control area to the hatchery. Although the SFS platform
addresses specific movements in an outbreak caused by a known agent, once established, risk assessments and models developed for one disease or closely related commodity can be adapted to another disease or commodity with minimal effort.

An emergency response that enables continuity of business for agriculture sectors effectively and rapidly ensures that disasters are handled in both an economically and environmentally sustainable way. Farmers are not only dodging financial catastrophe caused by having to needlessly destroy animals, birds, crops, and/or products, but they are also avoiding the unnecessary wastage of resources including feed, water, and energy that go into raising livestock and poultry and/or growing crops. Animal welfare is protected because the animals raised are allowed to live out their useful productive lives or be safely harvested. In addition, the farmer and surrounding community are spared the potential environmental issues that can accompany mass carcass disposal and the potential emotional or health issues after being exposed to massive numbers of dead animals. Keeping our farmers in business during disasters is the ultimate goal of the SFS plans and their continuous production will contribute immensely to maintaining the sustainability of the food system. Having a safe and sustainable food supply also directly benefits public health and every effort must be made to reduce any remaining threat to public health and food safety.

### 4.3. Secure food system opportunities at the national, regional, state, and local level

While there is an ongoing coordinated effort to utilize SFS plan tools and guidance to meet national needs, the adoption and implementation of these tools and guidelines lies at the state level. The authority and responsibility of emergency preparedness and response resides with the states, but ultimately there is the need for interstate movement that requires both a regional and national approach and understanding as well.

Currently, there is limited coordination of state, regional, and national SFS emergency preparedness efforts. Some states are active, while others are doing very little, and in most states the efforts are not well-coordinated across commodities or agencies. The different commodities (beef, dairy, pork, poultry) are active to varying degrees. For example, the National Pork Board is promoting adoption of the biosecurity principles in the Secure Pork Supply plan. More established plans are in
place for the poultry industry, which is an industry that has been a leader in adoption and working with the states in major production states.

The cattle industry is also continuing their work in developing and furthering Secure Beef and Secure Milk Supply plans. Portions of the Secure Poultry Supply Plan are being adopted into the National Poultry Improvement Plant, but utilization of the managed movement portions will remain with the state. Regional approaches for adoption are underway for the Secure Milk Supply within the northeastern states. While Colorado is doing a state approach, California is doing a different and unique state approach. Wisconsin and Minnesota are attempting a regional approach, but that is in its early stages of development and has its challenges.

The SFS team at the University of Minnesota is now exploring the idea of expanding to plant commodities, specifically major crops. Plant disease and production experts are on board with assessing how the SFS platform can better protect plant commodities and how to approach industries to introduce the concept of a continuity of business platform. As in animal commodities, the key to the industry and regulator adoption of the SFS supply plans is solid outreach and

| Table 2. Summary of Some of the Roles and Responsibilities of Public and Private Partners during the 2015 Highly Pathogenic Avian Influenza Emergency Response in Minnesota that Facilitated the Permitting Movement of Broiler Hatching Eggs from a Breeder Farm in a Control Area to Hatchery. Since the movement of Broiler hatching eggs from premises within an HPAI Control Area moving to hatcheries represents a risk for disease spread, the movement can only be done by permit there are criteria that must be met to achieve a negligible to low risk of disease transmission. One of the criteria is that hatching eggs are moving from a premises that meets the criteria for a Monitored Premises designation and has a national premises identification number. The steps to achieve that are detailed below including specific actions by each of the stakeholders involved in the emergency response. |
|---|---|---|
| **Criteria**: Hatching eggs are moving from a premises that meets the criteria for a Monitored Premises designation and has a national premises identification number | **Steps to meet the Permit Guidance Criteria** | **Action to be Taken** | **Responsible Party** |
| Achieve monitored premises status with identification | Apply for National Premises Identification Number (PIN) | Industry |
| | Assign PIN | State and Federal Agency |
| | Record and Track PIN use | State and Federal Agency |
| Premovement RRT-PCR testing is negative | Determine appropriate sample size and protocol | Academia |
| | Collect samples | Industry |
| | Test samples, report results | State or Federal Agency |
| Epidemiological questionnaire is completed | Determine risky contacts | Academia and Industry Work Group |
| | Document contacts | Industry |
| Evaluate Production Parameters | Determine which production parameters are predictive of disease status | Academia and Industry Work Group |
| | Document that there is no unexplained mortality, no unexplained clinical signs, and no unexplained changes in production parameters | Industry |
| Biosecurity measures are acceptable to state and federal authorities. | Evaluate biosecurity measures that are precisely targeted to prevent HPAI | Academia and Industry Work Group |
| | Implement biosecurity measures and document implementation | Industry |

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accessibility of continuity of business materials (such as permit guidance and other documents). Additionally, because these plans are developed via strong public–private partnerships, both regulating agencies issuing permits and industry producers that need to acquire permits have an understanding of the science and feasibility of the permit requirements. Such an understanding alleviates possible discrepancies between those needing a permit and those issuing a permit during a chaotic disaster event.

Movement controls and limitations in any one livestock industry have the potential for significant impacts on other just-in-time production/delivery systems such as the corn and soybean industries, in addition to the downstream service providers (processing, transportation, retail, etc.); the domino effect will be real and tangible to many. Since neither production agriculture nor agricultural disasters honor state or national borders, emergency preparedness and response cannot stop at borders either. This requires adoption and coordination at regional if not national levels. Regional preparedness starts locally and is developed with scalability and regional adoption in mind. Targeted continuity of business outreach to educate specific local, state, and national regulatory (and industry) audiences who would be directly involved in continuity of business efforts during an outbreak is essential. Additionally, providing the same audiences with tools they can use to educate other groups or agencies that they think will be involved in disease preparedness or response efforts is also imperative.

Current SFS plans are not all-hazards based but rather are disease and commodity specific. There is potential to expand certain components and processes to an all-hazards planning process. Therefore, the SFS Plans can help us define preparedness and understand the all-hazards response to food animal agriculture emergencies.

5. Conclusion
The location, timing, and reach of the next disaster that will vastly affect the US agriculture production system cannot be predicted. However, experiences with foreign animal disease emergency response at state and regional levels and the current progress in the realm of agriculture disaster preparedness offer important insights into where the development of agriculture-focused emergency response processes and programs in any country should be headed. Some US states have existing agricultural emergency response systems that have been utilized and field-tested during animal disease emergencies such as HPAI, and refinement and expansion of those systems to the rest of the region or nation are laudable goals.

The emergency response expertise gained from HPAI events can be leveraged to guide the implementation and adoption of the process for other hazard-focused responses. As a result of the successfully piloted and executed response programs for HPAI, the poultry industry in the Midwestern United States has remained self-sustaining and environmentally and economically sustainable. Moreover, the industry has arguably improved due to the implementation of biosecurity practices that protect the birds from HPAI and other diseases. The success of these response programs and permitting process are largely due to the fact that they are supported by science-based plans, such as the SFS, that use a proactive risk assessment approach developed over multiple years through public–private partnerships. SFS-type plans and the proactive risk assessment approach, tools and guidance, as well as other current cross-commodity and regional efforts represent a promising beginning to the translation of the science-based and communication-oriented processes into multilevel response programs that may address multihazard threats in any agricultural system in the world. The complexities that accompany the just-in-time agriculture production system require immediate development of emergency response processes and programs that encompass all regional, state, provincial and national levels of response so that the agricultural sectors can continue producing food in a sustainable manner. At all levels, there should be a strong commitment to working with unity during an agriculture emergency regardless of the hazard. The ultimate goal is that, through proper collaborations and animal agriculture-specific efforts, the appropriate science
and communication strategies can be effectively developed so that all involved individual farmers or businesses, regional industries, and national commodities can all stay afloat during catastrophic disease or hazards events. If earnestly operationalized and socialized, the science and processes developed may become an approach to manage any hazard that threatens the vitality of agriculture.

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Source: Secure Poultry Supply (c) 2017; https://www.securebroilersupply.com/

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