

# Feedlot Sessions

Moderator: Cris Young

## The Feedlot: Frontline Ramifications of Agroterrorism

N.C. Speer, PhD, MBA

Department of Agriculture, 1906 College Heights Blvd, PO Box 41066, Western Kentucky University, Bowling Green, KY 42101, Phone: (270) 745-5959, Fax: (270) 745-5972, [nevil.speer@wku.edu](mailto:nevil.speer@wku.edu)

### Abstract

The beef industry plays an important role within the American economy mandating special consideration regarding terrorism threats. Deliberate introduction of Foot and Mouth Disease (FMD) poses the most influential and immediate threat to the industry. Given the lagging nature of identifying an outbreak, the rate of spread of a FMD outbreak would depend on the location of the epicenter(s) of the outbreak(s) and the extent of livestock and human movement out of the infected area(s). However, extended stop-movement orders across important geographical areas could impose serious ramifications upon the beef industry stemming from both direct and indirect economic effects. As such, improvement of security at the feedyard level possesses large upside potential. Ideally, all feedyard operations would operate within completely secure facilities, utilize dedicated and certified supply networks, and possess clearly outlined contingency plans in the event of an emergency. Such investment into basic planning and preventive security measures is critical to preventing potential commerce disruptions in business operations. Terrorism threats are relatively new to agriculture. The looming threat requires the industry to increasingly focus upon food security and requires coalitions across multiple disciplines. Producers at all stages of the production chain need to become increasingly proactive to ensure commerce continuity and avoid catastrophic losses.

### Résumé

L'industrie du bœuf joue un rôle important dans l'économie américaine nécessitant une réflexion concernant la menace de terrorisme. L'introduction délibérée de la fièvre aphteuse représente la menace la plus immédiate et la plus importante pour l'industrie. Comme il existe toujours un délai dans l'identification de l'agent responsable d'une flambée, l'évolution spatiale d'une flambée de fièvre aphteuse dépendrait de la localisation de l'épicentre de la flambée et de l'amplitude du mouvement des humains et du bétail dans la zone

infectée. Toutefois, le bannissement à grande échelle des mouvements entre les zones géographiques importantes aurait de sérieuses ramifications pour l'industrie du bœuf en raison des conséquences économiques directes et indirectes. Ainsi, l'amélioration de la sécurité au niveau du parc d'engraissement pourrait avoir de grandes répercussions positives. Idéalement, tous les parcs d'engraissement devraient fonctionner dans un environnement complètement sécurisé, utiliser des réseaux de distribution certifiés et attribués et posséder des plans d'urgence bien détaillés en cas de nécessité. Un tel investissement dans la planification de base et dans les mesures de sécurité préventives est essentiel afin de prévenir des interruptions du commerce dans les entreprises. Les menaces terroristes sont relativement nouvelles en agriculture. Cette menace latente devrait inciter l'industrie à mettre de plus en plus d'accent sur la sécurité des aliments et à former des coalitions entre les différents intervenants. Les producteurs à tous les niveaux dans la chaîne de production doivent devenir de plus en plus proactif afin d'assurer la continuité du commerce et d'éviter des pertes catastrophiques.

### Introduction

The proportion of disposable income dedicated to food purchases in the United States (US) has shrunk from over 25% in 1933 to less than 10% in each of the first seven years of the 21<sup>st</sup> century.<sup>16</sup> Those benefits have been derived from a food industry which is increasingly effective, efficient and productive: "The efficiency of this system has enabled US agriculture to provide an abundant, safe and affordable food supply for US citizens and to be a dominant supplier of food and fiber to the rest of the world's population."<sup>9</sup> All said, those aspects make the food industry essential to the overall strength of the US economy.

Food and fiber production is a large and significant industry. Agriculture's balance sheet includes total assets projected to exceed \$2.5 trillion in 2008.<sup>18</sup> Receipts derived from crops and livestock are forecast to approach \$315 billion during 2008 (\$175 and \$139

billion, respectively). Direct production activity also spills over into supporting industries as purchased inputs exceed \$185 billion; meanwhile, net value added to the national economy will be record-large, at nearly \$145 billion in 2008.<sup>18</sup>

Cattle and cattle products represent the single largest contributor to the overall farm economy, comprising 15% of agriculture's total economic output: 2008's cattle and calf production is expected to equal \$50 billion.<sup>18</sup> More importantly, the retail equivalent value of the U.S. beef industry approaches \$80 billion plus an additional \$1-to-2 billion in exports; additionally, the value of hides and offal is equivalent to nearly \$3.5 billion.<sup>26</sup> The beef industry's aggregate economic output is roughly equivalent to \$85 billion annually.

The beef industry's reach goes well beyond the output outlined above. Utilization of a general economic multiplier of 2.5 equates the beef complex's economic impact to approximately \$200 billion in 2008. The beef industry, on a nationwide basis, also supports nearly 1.4 million full-time equivalent positions (FTEs); 212,000 jobs are directly associated with the industry, while an additional 1.2 million persons have employment related to, or supported by, cattle production.<sup>25</sup>

Regardless of a final number, it's clear that agriculture, and the beef industry in particular, plays an important role within the American economy mandating special consideration regarding terrorism threats and subsequent erosion of national security. Senator Susan Collins (R-ME) points out that, "In the war on terrorism, the fields and pastures of America's farmland might seem at first to have nothing in common with the towers of the World Trade Center or busy seaports. In fact, however, they are merely different manifestations of the same high-priority target, the American economy."<sup>10</sup> Similarly, Dr. David Franz, Director, National Agricultural Biosecurity Center, explains that, "Agroterrorism is not about killing cows. It's about striking at the fundamental heart of our economy."<sup>31</sup> Given agriculture's importance to the economy, any type of terrorist attack, even if partially successful, could deal a "crippling" blow to both the US and world economies.<sup>33</sup>

In fact, terrorism's primary objective is largely focused upon destroying national security through a weakened US economy. Congressional Research specifically points out that a terrorist event does not need to induce human casualties in order to be effective or induce significant economic consequences.<sup>28</sup> Turvey *et al* further explain, with reference to agriculture, that if "...the objective is to kill humans, then it is unlikely that the food system would be used as a vector since more powerful biological agents (e.g. anthrax, plague, small pox) than food-borne illnesses or zoonoses are available [and thus] agroterrorism can be distinguished

from bioterrorism in that the former is directed towards economic damage while the latter is a direct assault on human life."<sup>44</sup> Economic destruction and disruption makes attacks upon the agriculture industry an effective and preferred method to do so.<sup>12</sup>

### Foot and Mouth Disease: Response Complexity

Deliberate introduction of Foot and Mouth Disease (FMD) poses the most influential and immediate threat to agriculture, both biologically and economically. Listed below are several means by which the virus could be easily introduced and subsequently dispersed throughout the food production system in the US:

- Animals carrying the virus are introduced into susceptible herds.
- Animals are exposed to contraband materials such as food, hay, feedstuffs, hides, or biologics contaminated with the virus.
- People wearing contaminated clothing and/or using contaminated equipment (including tractors and/or trucks) to transmit the virus to susceptible animals.
- Contaminated facilities (including feedyards, sale barns, trucks etc...) are used to hold and/or transport susceptible animals.

The inherent nature of the beef industry's infrastructure makes the virus a particularly serious threat. The beef industry's supply chain is highly intricate and interrelated with heavy reliance upon transportation as the foundation of its infrastructure. That dependence, though, possesses a downside and serves as a distinct risk component: Charlotte Robinson, Virginia-based Director of Veterinary Services for Code 3 Associates explains that the mobility of US agriculture – long thought of as an asset – also could be its Achilles heel, should bioterrorists strike.<sup>45</sup>

Given the lagging nature of identifying an outbreak, the rate of spread of a FMD outbreak would depend on the location of the epicenter(s) of the outbreak(s) and the extent of livestock and human movement out of the infected area(s). Spread would be even more rapid in areas which are densely populated and/or where there is considerable livestock movement between operations.<sup>11</sup> If the disease found itself at a point in the system that serves as a concentrated hub for marketing, the consequences and response complexity grows exponentially. Operation Crimson Sky estimates that introduction of FMD into the US would result in dispersion to 35 states within 10 days.<sup>1</sup> Similarly, the North Carolina Department of Agriculture depicts simulation of a FMD attack at five separate locations: assuming a requirement of five days from infection to detection, the disease would have spread to 23 states,

and within a month's time would likely cover as many as 40 states.<sup>42</sup>

Management of an outbreak from a logistical standpoint while also minimizing unintended negative consequences becomes very difficult. Casagrande explains that if a large-scale or regional outbreak were to occur it "...would likely overwhelm the response capability of this service (APHIS: Animal and Plant Health Inspection Service – USDA), allowing for the catastrophic spread of disease."<sup>6</sup> Given that scenario—FMD introduction coupled with failure to identify and halt the spread of the disease in a relatively short period of time—it is estimated that FMD's proliferation may last for approximately one year and potentially affect 30-to-70% of the livestock in the US.<sup>11</sup>

### **Foot and Mouth Disease: Direct Effects**

From a broad perspective, a terrorism attack upon agriculture would create economic costs on a number of fronts. Direct costs include:

- 1) Disruption of food production's supply chain.
- 2) Disruption of export markets and/or imposition of trade sanctions.
- 3) Quarantine and eradication costs.
- 4) Production losses.
- 5) Disposal of contaminated products and/or destroyed animals.
- 6) Costs associated with subsequent law enforcement and situational logistics.

The United Kingdom (UK) FMD outbreak in 2001 serves as the only actual model from which to base potential ramifications of a widespread FMD event in the US. The UK epidemic affected over 9,000 farms and required destruction of over four million animals. Accurately assigning economic costs to such a pandemic event is difficult to assess:

FMD is a disease that is almost defined economically, yet even the British could not identify the true costs or their impact. Mitigating losses in an American context demands that these costs be identified and attributed so that steps can be taken to minimize them. Much more work needs to be done to understand the potential financial impacts of FMD across the whole economy so that such important policy is not based on anecdotal information.<sup>4</sup>

Assessment of overall economic impact in Great Britain is highly varied, ranging from U.S. \$3.6 – 11.6 billion;<sup>27</sup> other estimates on a per-animal basis (on which indemnities were to be paid) range from US \$1,389 – 4,477.<sup>11</sup> If an outbreak were to occur in the US, resulting from targeting areas in which high-valued livestock are concentrated, e.g. central plains,

feedyard losses alone may run as high as \$12-16 billion.<sup>46</sup> Secondary effects must also be considered. For instance, reduced livestock populations also correlate to diminished quantities of grain demanded, thereby reducing grain prices and subsequently affecting such producers.<sup>35</sup> Considerations must also be made for supporting industries including trucking companies, supplemental feed dealers, auction markets, implement dealers, etc... Based upon the events that occurred in the UK, USDA's comprehensive analysis outlines the potential economic effect in the US:

A crude estimate of the economic costs of a FAD (Foreign Animal Disease) across the nation is estimated at \$20.5 billion assuming the same percentage loss of GDP as experienced in the UK in 2001 when an unintentional outbreak occurred. USDA believes this is a low estimate because of the differences in the economies and livestock industries between the US and UK. Evaluating potential lost livestock value from targeted attacks on a few high-density states could result in direct animal losses of \$20 billion. Loss of export markets could range up to \$5.5 billion a year. A full analysis incorporating upstream and downstream effects is not attempted. However, applying a reasonable range of multipliers of two to three to the livestock loss value suggests a national impact of \$40 to \$60 billion.<sup>46</sup>

The direct impact to production agriculture often includes accounting for location(s) of infection, loss of foreign markets, indemnification, and subsequent impact upon grain markets. That process, though, doesn't incorporate consideration of secondary effects, including depressed prices stemming from declining demand, loss of various marketing options, and trade disruption costs for non-infected cattle.

### **Foot and Mouth Disease: Indirect Effects**

Sole consideration of the direct effects disregards the long-term shifts in commerce that might occur as a result of a terrorist attack. However, indirect costs are more difficult to ascertain. They are primarily associated with the demand side of the price equation and largely dependent upon projected consumer behavior and international response. From an indirect cost perspective, both domestically and globally, it's possible that producers of all commodity items may experience diminished independence following an agroterrorism attack. The period following recovery of production and marketing will likely be increasingly influenced by end-users as downstream entities seek to minimize future economic risk.<sup>40</sup>

The effect upon domestic consumers is especially important. In general, consumers will experience a relative loss of income upon onset of an agroterrorism event due to the relative decline in available food supplies and the subsequent rise in the price of food.<sup>37</sup> From an industry perspective, longer-lasting effects must also be considered with respect to consumers – namely the potential for “hysteresis”.<sup>44</sup> Consumer fear possesses several ramifications for the agriculture economy. One, the original shock causes a downward shift in the demand curve, lowering demand across the board. Two, enhanced risk perception causes demand to become more inelastic; by becoming more inelastic, consumers become more resistant to decreases in prices that could restore demand to its pre-attack level. Given those factors, the primary question becomes whether it would even be possible to regain domestic confidence in the affected commodity(s); and if so, how much time would such a recovery require?

International markets also present great challenges: restoration of confidence in food security and safety among foreign customers is a daunting task. Export markets may be eliminated altogether. Alternatively, foreign restrictions, even upon the lifting of embargoes, may possess long-term impacts on the way business is conducted and may also impose costly safeguards to resume commerce.<sup>32</sup>

The most appropriate example of some of the potential effects from a commerce perspective surrounds the recent discovery of a single case of bovine spongiform encephalitis (BSE) in the US (December 23, 2003). Despite domestic demand remaining robust in 2004, the incident has been estimated to have cost the US beef industry approximately \$3.5 billion during 2004 alone,<sup>7</sup> those losses directly attributable to the closure of foreign markets. More difficult to assess, and not accounted for above, are the ongoing costs associated with increased monitoring, investigative science, establishment of new safeguards, efforts to reopen export markets, and opportunity costs associated with those endeavors. In addition, the industry’s commerce patterns have also shifted stemming from trade disruption. That has made ongoing business decisions difficult<sup>38</sup> and yielded increased market volatility.<sup>39</sup>

Simultaneously, there also exists a high likelihood for the virus to cross the Mexican and Canadian borders. For example, such an event in Canada would severely hamper the Canadian economy, as one in seven jobs are directly related to the food animal industry.<sup>5</sup> Meanwhile, Tong explains that if an FMD case were to occur in Canada the disruption would be especially devastating to Canada’s economy, especially on the heels of recent BSE trade complications.<sup>43</sup> And as recent BSE events have demonstrated, trade among NAFTA partners would likely be restricted for a period of time; that

in-and-of-itself poses important consequences for the beef industry.

### Front-line Ramifications

The beef industry is especially vulnerable to a potential agroterrorism attack. It is fragmented and complex, consisting of over 750,000 total operations; more than 75% of these operations consist of farms/ranches which maintain less than 50 animals.<sup>30</sup> Meanwhile, much of the industry’s marketing is centralized in the central plains region, with cattle feeding and packing plants located in Texas, Oklahoma, Nebraska and Colorado: “...import and export information confirms conclusions of others that cattle tend to move toward the center of the USA.”<sup>21</sup> Because of that centralization and the beef industry’s economic significance to agriculture, FMD, if manifested in the central plains, would prove very costly.

If FMD were discovered, implementation of a “stop movement” order would occur to prevent further spread. It’s possible the order might span a geographical area; the boundaries would likely be delineated either by state borders or sectors outlined by major natural borders (such as rivers) and/or common highways but would correspond to important regions of commerce. Such orders would shut down commerce in the region and would possess serious economic consequences.

Major beef processing operations in the Kansas/Texas region represent a daily harvest capacity of approximately 38,000 head. If a regional “stop-movement” order were necessary to control spread of the FMD virus in this geographic vicinity all transactions among feedyards and packing plants would immediately cease—representing approximately 40% of total US fed-beef commerce. In that case, the economic ramifications of a “stop movement” order would be as follows:

- 38,000 head marketed / day
- 1,250 lb / head average
- \$90 / cwt market average
- Equivalent of ~\$42.75 million / day
- 3.5 multiplier = ~\$150 million / day
- Total economic impact from lost cattle sales = ~\$190-195 million / day

The net cost to the economy would result from lost revenue stemming from this hypothetical regional “stop movement” order. More astounding, shutdown of packer-feedlot transactions, expressed from the perspective of two eight-hour shifts, is the equivalent of nearly \$200,000 per minute!

If the order lasted only several days, much of the lost revenue could be recaptured and the long-term economic impact would be minimal. Conversely, though,

if the “stop movement” order was extended (and some informal estimates indicate it might be enforced for 180 days), the ramifications would be very serious. In that event, several other business considerations must also be made if the “stop movement” order possessed significant duration:

- 1) Domino effect upon the cattle industry, including shutdown of sale barns and direct sales. Secondary consequences stemming from commerce cessation would be felt throughout the United States, not just in the region of implementation.
- 2) Law enforcement expenses, including managing road blocks.
- 3) Costs associated with investigation of terrorist activity.
- 4) Temporary (or permanent) layoff of meat-packing plant employees (Given that a sizeable portion of the nearly 19,000 persons employed in Kansas by the food processing industry work directly or indirectly for beef processors,<sup>24</sup> there exists sizeable potential for increased community hardship and/or crime as a consequence.)

Alternatively, the beef industry’s top five customers consist of the following:<sup>14</sup>

- 1) Wal-Mart (2.0 billion lb/year) (0.9 billion kg)
- 2) McDonald’s (1.0 billion lb/year) (0.45 billion kg)
- 3) Safeway (0.9 billion lb/year) (0.4 billion kg)
- 4) Costco (0.8 billion lb/year) (0.36 billion kg)
- 5) Sam’s Club (0.8 billion lb/year) (0.36 billion kg)

These five companies combine for sales of over 4.5 billion lb (2 billion kg) of beef per year. That level of production requires harvest of approximately 25-30,000 head per business day. As such, commerce shutdown in the region could be equated to cutting out the needs of these companies to do commerce...and then some. Moreover, ramifications also spill over to other agricultural commodities and industries; e.g., long-term implications for the dairy industry may include “proof of negative status” in order to ship milk both within and across state lines.<sup>23</sup>

### Application

Feedyards are relatively unique with respect to animal agriculture, and possess some important considerations related to agroterrorism. On one hand, they’re similar to facilities geared towards poultry or hog production—a relatively large number of animals are managed in a concentrated manner. On the other hand, feedyard production requires a larger land mass; as such, geographical requirements associated with production represent some distinct security challenges. Those concerns are compounded by truck traffic associ-

ated with daily operations, all of which are potential biosecurity threats. In combination, these factors make the sector highly vulnerable to criminal activity.

Feedyard security typically has been limited to installation of perimeter fence for the purpose of minimizing vehicle access to the facility. However, many feedyards also possess alternate service entrances. These alternate entrances are generally found opposite of the main entrance, and the geographical distance from where employees are concentrated makes reliable traffic monitoring difficult to impossible. Simultaneously, other efforts to maintain comprehensive security and/or surveillance efforts are “limited”<sup>33</sup> and “insufficient”.<sup>34</sup>

Improvement of security possesses large upside potential. Ideally, all feedyard operations would operate within completely secure facilities, utilize dedicated and certified supply networks, and possess clearly outlined contingency plans in the event of an emergency. The relative lack of investment and/or concern about security and surveillance is understandable,<sup>8</sup> and likely stems from the perception that such efforts provide little or no tangible economic return. However, feedyard operators are encouraged to consider some non-tangible sources of economic benefit to cattle feeding operations. Namely, improved security efforts often serve as deterrence to potential criminals, thereby minimizing possible criminal behavior and the need to physically monitor all geographical areas. More importantly, though, investment into basic planning and preventive security measures is critical to preventing potential commerce disruptions in business operations. “The most dangerous situations arise when the threat is ambiguous. This leads managers to ignore or discount the risk and take a wait-and-see attitude. Such an approach can be catastrophic.”<sup>36</sup>

### Summary

Agroterrorism is not about threatening individual lives; rather, an attack is more appropriately defined as being “...about terror, money, mass slaughter...”.<sup>3</sup> An attack that disrupts the food chain would possess some important ramifications. Attempts to outline specific consequences of such an attack are difficult. That’s especially true when considering the fact that terrorist attacks are designed to maximize economic impact and actual costs following an event may well exceed those previously outlined.<sup>37</sup>

Additionally, ramifications surrounding politics and/or policy must also be considered. Aside from economic considerations, a successful terrorist attack could overwhelm law enforcement while simultaneously undermining public confidence in, and support for, governmental agencies.<sup>34</sup> That appears especially likely given that 62% of survey respondents indicate

they lack confidence that the food supply is secure from terrorism. Meanwhile, 41% consider governmental agencies to hold the primary responsibility when it comes to food defense.<sup>41</sup>

Agriculture's entire "production, processing and marketing system" is at risk to a variety of agroterrorism attacks at a number of levels.<sup>22</sup> The looming threat requires the industry to increasingly focus upon food security while taking "...steps to try to minimize exposure to such [terrorist] risks."<sup>22</sup> That endeavor, though, is a complex process and requires coalitions across multiple disciplines:

Introducing adequate security to protect our food supplies should be a top national priority. There are a number of actions that should be pursued to reduce the risk. First, key relationships need to be strengthened among the constituents throughout the food industries. There have been long-standing tensions among farmers, feed yards, packing companies, food processing plants and retailers as they all jockey to maintain a piece of the industry's thin profit margins...What is missing is the kind of regular forum where operators meet with security experts as they now do at Logan Airport in Boston.<sup>20</sup>

The threat is an enduring one and "...because there is no enemy government or army to surrender, there can be no clear-cut moment of victory."<sup>19</sup> In order for consumers to continually have access to a safe, viable, abundant and inexpensive food supply, prevention of such an attack is mandatory. Meanwhile, prevention must be relatively non-intrusive for the agriculture industry to maintain its commercial efficiency and productivity. Clearly, though, steps to implement preventive measures are far less intrusive than response to an attack. However, despite the fact that 1) agriculture is one of 17 "Key Infrastructure and Key Resource Sectors" by the Department of Homeland Security<sup>13</sup> and 2) testimony outlining previous GAO reports about the continued need for vigilance relative to FMD,<sup>15</sup> the department's respective budget for agriculture does not include any specific line items.<sup>29</sup>

Terrorism threats are relatively new to agriculture. Stakeholders at all stages of the production chain need to become increasingly aware of, and proactive about, food security measures to ensure continuity of operations while avoiding catastrophic losses.

### Literature Cited

1. ANSER: *Advancing National Strategies and Enabling Results. Operation Crimson Sky*. Arlington, VA. 2003.
2. Blandford D: The agricultural economics of terrorism: markets in peril? international trade dimensions. Agricultural Economics of Terrorism Symposium, Am Agri Econ Assoc, Long Beach, CA, 2002.
3. Brandt AW; Sanderson MW, DeGroot BD, Thomson DU, Hollis LC: Biocontainment, biosecurity and security practices in beef feed-yards. *J Am Vet Med Assoc* 232:262-269, 2008.
4. Breeze R: Agroterrorism: betting far more than the farm. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice and Science* 2:1-14, 2004.
5. Canadian Animal Health Coalition: N.A. agrifood market integration: risk management (animal health and emergency management). *NAAMIC (NA Agriculture Agrifood Market Integration Consortium) Conf*, 2004.
6. Casagrande R: Biological terrorism targeted at agriculture: the threat to US national security. *The Nonproliferation Review*, Fall/Winter 2000, pp 92-105, 2000.
7. Cattlemen's Beef Promotion and Research Board: *Beef Demand Climbs Nearly Eight Percent in 2004*. Englewood, CO, February 2, 2005.
8. Chalk P: The bio-terrorist threat to agricultural livestock and produce. Testimony, US Senate Governmental Affairs Committee Hearing on Agroterrorism, November 19, 2003.
9. Collins K: Statement, U.S. Senate Committee on Appropriations; Subcommittee on Agriculture, Rural Development and Related Agencies. Washington, DC, May 17, 2001.
10. Collins S: Statement, U.S. Senate Committee on Governmental Affairs: *Agroterrorism: the threat to America's breadbasket*. Washington, DC, November 19, 2003.
11. Consortium: Animal Disease Risk Assessment, Prevention, and Control Act of 2001. PL107-9 Federal Inter-agency Working Group. Appendix 6.
12. Davis RG: Agroterrorism: need for awareness. Executive Summary. Testimony: US Senate Governmental Affairs Committee Hearing on Agroterrorism, November 19, 2003.
13. Department of Homeland Security. Washington, DC, 2008.
14. Doud G: Top 5 beef industry customers. Live Cattle Marketing Committee, National Cattlemen's Beef Association Annual Convention, San Antonio, TX, 2005.
15. Dyckman LJ: Bioterrorism: a threat to agriculture and the food supply. Testimony, U.S. Senate Committee on Governmental Affairs, November 19, 2003.
16. Economic Research Service: *Food CPI, Prices and Expenditures: Food Expenditures by Families and Individuals as a Share of Disposable Personal Income*. US Dept Agriculture, Washington, DC, 2007.
17. Economic Research Service: *Amber Waves: The Economics of Food, Farming, Natural Resources and Rural America. Farm, Rural and Natural Resources Indicators*. US Dept of Agriculture. Washington, DC, April, 2008.
18. Economic Research Service: *Farm Income and Costs: U.S. and State Farm Income Data*. Washington, DC, 2008.
19. Fallows J: Success without victory. *The Atlantic Monthly*. Jan/ Feb, pp 8090, 2005.
20. Flynn S: America the vulnerable: how our government is failing to protect us from terrorism. New York, Harper Collins Publishers, with the Council on Foreign Relations, 2004.
21. Forde K; Hillberg-Seitzinger A, Dargatz D, Wineland N: The availability of state-level data on interstate cattle movement in the United States. *Prev Vet Med* 37(1-4):209-17, 1998.
22. Horn FP, Breeze RG: Agriculture and food security. *Annals of the New York Academy of Sciences* 894:9-17, 1999.
23. Hullinger P: FMDV "negative status testing": do we have the tools? where are the gaps? NIAA Symposium on Business Continuity and Disaster Recovery Planning, Louisville, KY, 2006.
24. Kansas Livestock Association, Topeka, KS.
25. Lawrence JD, Otto D: *Economic Impact of the United States Beef Industry*. National Cattlemen's Beef Association, Englewood, CO, 2003.
26. Livestock Marketing Information Center, Englewood, CO.
27. Matthews K, Buzby J: Dissecting the challenges of mad cow & foot-and-mouth disease. *Agricultural Outlook*, USDA Economic Research Service, Washington, DC, 2001.

28. Monke J: Agroterrorism: threats and preparedness. *CRS Report for Congress*. Congressional Research Service. The Library of Congress, Washington, DC, 2004.
29. Monke J: Agroterrorism: threats and preparedness. *CRS Report for Congress*. Congressional Research Service, Washington, DC, 2007.
30. National Agricultural Statistics Service, US Dept of Agriculture, Washington, D.C.
31. Nelson B: *Danger in the Fields. New Target for Terror?* New York, Newsday Publications, July 26, 2004.
32. National Research Council: *Countering Agricultural Bioterrorism*. National Research Council Committee on Biological Threats to Agricultural Plants and Animals. National Academy of Sciences. National Academies Press, Washington, DC, 2003.
33. Polyak MG: The threat of agroterrorism: economics of bioterrorism. *Georgetown J of International Affairs*. Summer/Fall, 2004.
34. RAND: Agroterrorism: What Is the Threat and What Can Be Done About It? Research brief, National Defense Research Institute, Santa Monica, CA. 2003.
35. Ray DE: Bioterrorism – the high economic costs of an attack. *MidAmerica Farmer Grower*. Vol 19, No 42, 2002.
36. Roberto MA, Bohmer RMJ, Edmonson AC: Facing ambiguous threats. *Harvard Business Review* 84:106-113, 2006.
37. Schweikhardt D: The potential impact of terrorism in the agri-food system. The Coalition on Funding Agricultural Research Missions (CoFARM), *8<sup>th</sup> Annual Science-Engineering-Technology "Congressional Visits Day" (CVD)*, April 2-3, 2003, Washington, DC. 2004.
38. Speer NC: *Monthly Market Profile*. Western Kentucky University, Bowling Green, KY. December, 2004.
39. Speer NC: *Monthly Market Profile*. Western Kentucky University, Bowling Green, KY. January, 2005.
40. Speer NC: *Monthly Market Profile*. Western Kentucky University, Bowling Green, KY. February, 2005.
41. Stinson TF, Kinsey J, Degeneffe D, Ghosh K: Defending America's food supply against terrorism: Who is responsible? Who should pay? *Choices: The Magazine of Food, Farm and Resource Issues*. American Agricultural Economics Association, 22:67-71, 2007.
42. Tickle J: Personal communication, North Carolina Department of Agriculture, Raleigh, NC. 2006.
43. Tong M: The Wages of Fear: Terror attacks on Food Supply Would Cripple Economy, Says Researchers. *University of Guelph Research News*. January 28, 2004.
44. Turvey CG, Mafoua E, Schilling B, Onyango B: Economics, hysteresis and agroterrorism. Principal paper, Food Policy Institute, Rutgers University, Rutgers, NJ, 2003.
45. Univ. of Missouri: US Ag's Mobility a Terrorism Curse, Blessing. Univ. of Missouri News Release, Nov. 2, 2004.
46. USDA: *Economic Impact of a Foreign Animal Disease (FAD) Outbreak Across the United States*, Washington, DC, US Dept of Agriculture, 2004.