Alternative Control Strategies with Uncertain Trade Barriers for Foot-and-Mouth Disease in Feedlot Operations

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BACKGROUND

The depopulation and disposal of large numbers of cattle poses difficult challenges for environmental management and resource requirements.

Although the morbidity rate for FMD is high, the mortality rate in adult animals is low, meaning that many animals will recover following infection.

Alternative methods are needed for minimizing disease spread while **allowing high value fed beef cattle to reach their intended purpose.**

USDA photo by Alice Welch

OBJECTIVES

We informed FMD response strategy planning with an aim to enhance cattle industry **business continuity** in the aftermath of FMD. This was accomplished as follows:

- We examined the epidemiologic consequences of allowing FMD infected feedlot cattle to recover on site and move to controlled slaughter.
- We estimated the levels of trade sanctions that could be tolerated under different levels of risk aversion in order to gain the benefits of controlled slaughter.

APPROACH

Part 1: Epidemiologic Modeling:

- North American Animal Disease Simulation Model (NAADSM) version 3.2.19.
- The animal population covered Arkansas, Colorado, Kansas, Louisiana, New Mexico, Oklahoma, and Texas.
- 12 types of farms, including 5 different sizes of feedlots.

Part 2: National, quarterly partial equilibrium model

- Simulates the effect of supply shocks from NAADSM, domestic demand shocks, and trade shocks (Paarlberg *et al.* 2008).
- 33 livestock categories and 11 final products (7 animal products and 4 grains) as well as intermediate input demand.

Business Continuity: describes the processes and procedures an organization puts in place **to ensure that essential functions can continue during and after a disaster.**

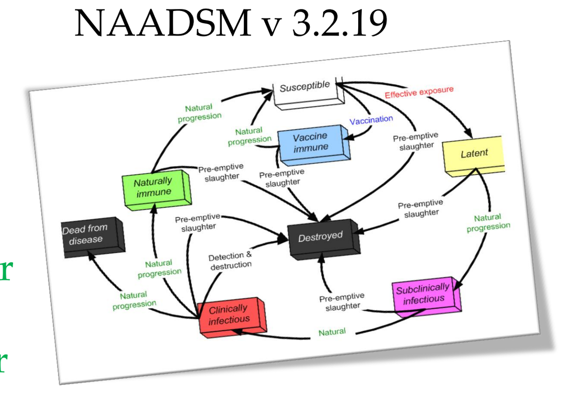
MODELS

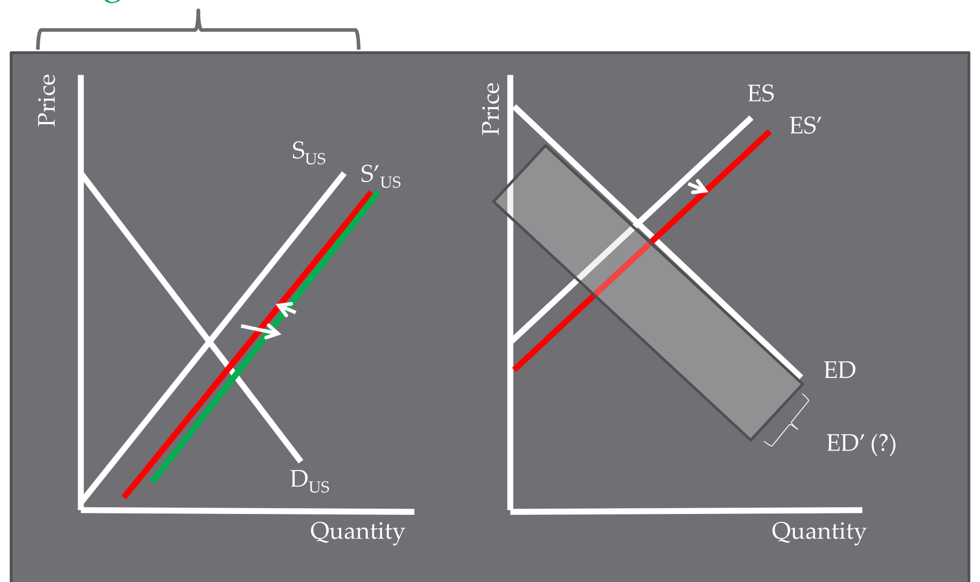
Production Shock

NEGATIVE:
- Infected Animals Depopulated

POSITIVE:
- Controlled Slaughter Surge
- Vaccinates Slaughter Surge

NAADSM v 3.2.19



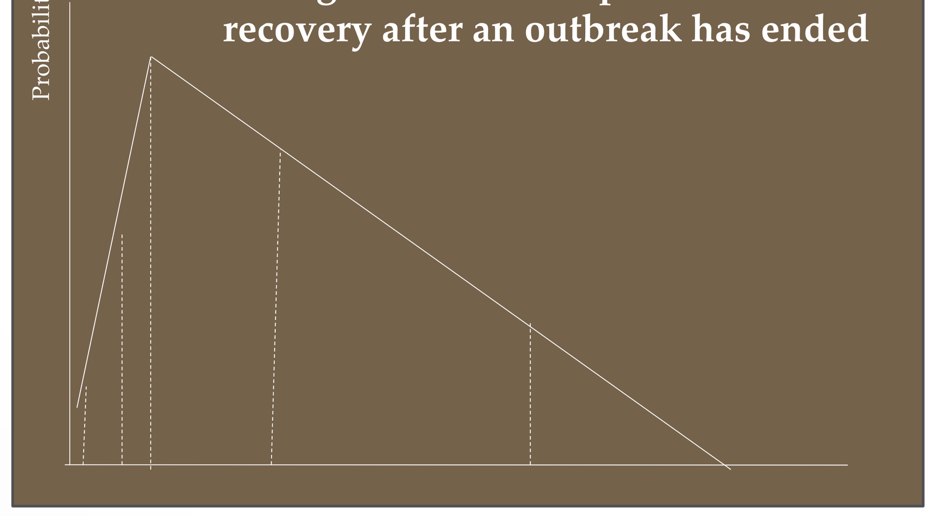


Simplified Partial Equilibrium Representation

Trade Shock: Uncertain Trade Barriers

The time to trade recovery is based on random draws from a triangle distribution, parameterized from historical FMD recovery times. FMD has resulted in a few very long recovery times (e.g. UK 2001 and Taiwan 1997) but many recovery times are short (Johnson and Stone, 2011).

500 draws were taken from the triangle distribution, and the 5th, 25th, 50th, 75th, and 95th percentile recovery times were estimated. These 5 recovery times were added to the duration of each outbreak from the epidemiologic model, and applied in the partial equilibrium model.



Triangle distribution pdf of trade recovery after an outbreak has ended

REFERENCES

- Johnson, K.K. and K.L. Stone. 2011. "Export Market Recovery Post Livestock Disease Outbreak – Cattle." Livestock Marketing Information Center Fact Sheet.
- Galli, M. 2011. Movement restriction implications on potential welfare slaughter for Texas High Plains feedlots. Master's thesis, Texas A&M University, USA.
- Paarlberg, P.L. , A.H. Seitzinger, J.G. Lee, and K.H. Mathews. "Economic Impacts of Foreign Animal Disease." Washington, DC: US Department of Agriculture/ Economic Research Service, Research Report Number 57, May 2008.

SCENARIOS

Baseline Scenario

Movement controls
- 90% reduction in Control Area (10 km from infected)
- 50% to 70% reduction in Surveillance Zones

Depopulation
- All infected herds
- Traced herds with direct contact with infected herds

Vaccination
- 10 km ring around infected herds

Alternative 1

Movement controls
- 90% reduction in Control Area (10 km from infected)
- 50% to 70% reduction in Surveillance Zones

Depopulation
- All infected herds, **except feedlots**
- Traced herds with direct contact with infected herds

Vaccination
- 10 km ring around infected herds

Alternative 2

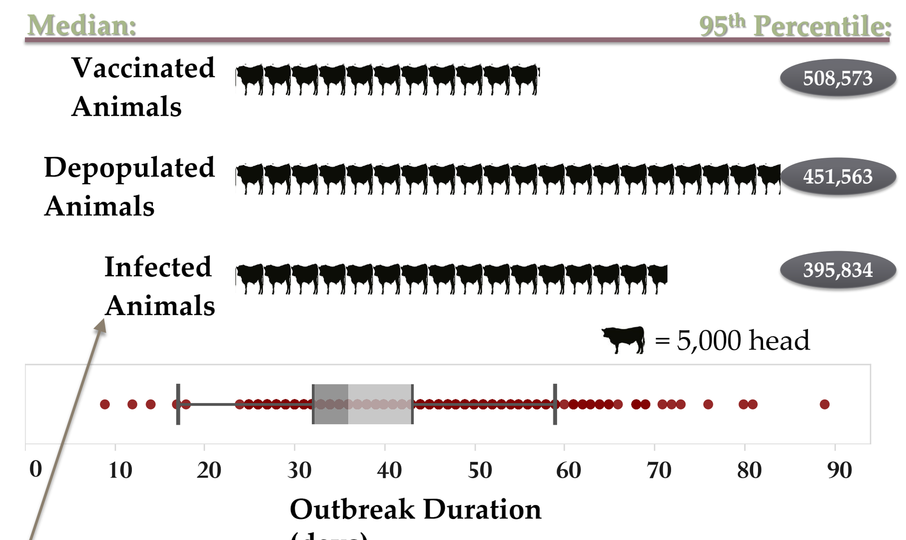
Movement controls
- 90% reduction in Control Area (10 km from infected)
- 50% to 70% reduction in Surveillance Zones

Depopulation
- All infected herds, **except feedlots**
- Traced herds with direct contact with infected herds

Vaccination
- 10 km ring around infected herds, **except feedlots**

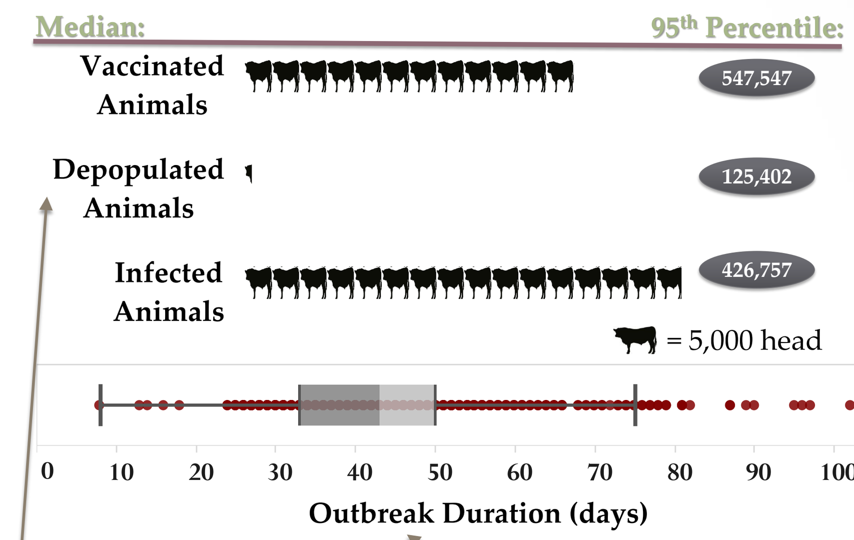
RESULTS

Outbreak characteristics (1000 runs)



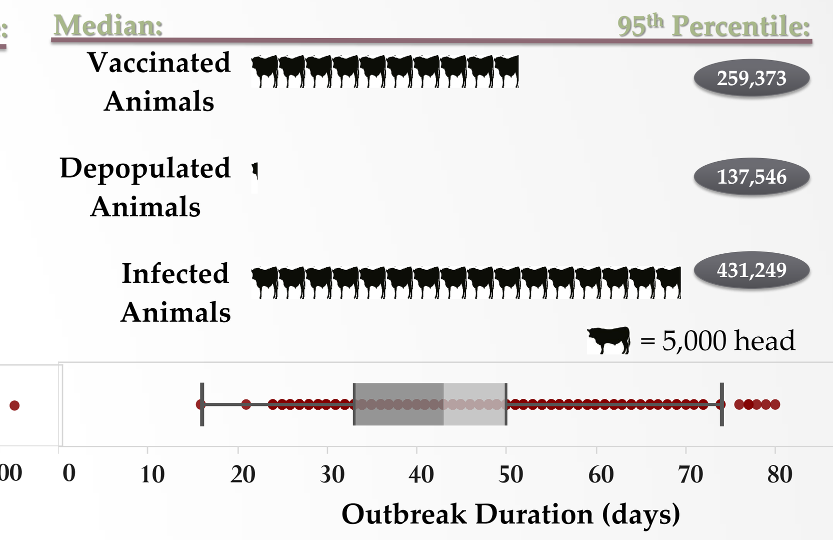
No significant difference in the number of infected animals across strategies

Outbreak characteristics (1000 runs)



72-98% reduction in animals destroyed

Outbreak characteristics (1000 runs)



Controlling for the number of infected feedlots, time to first detection, and wait time for depopulation, the odds of having an outbreak last longer than the 75th percentile of outbreak duration are 8 times greater under alternatives 1 and 2 (p<0.000)

Economic consequences

Median: | 95th Percentile:

Producer Welfare Loss — $16.6 B ($ = $1B)

No significant difference in the producer welfare loss was found across strategies.

Economic consequences

Median: | 95th Percentile:

Producer Welfare Loss — $17.1 B ($ = $1B)

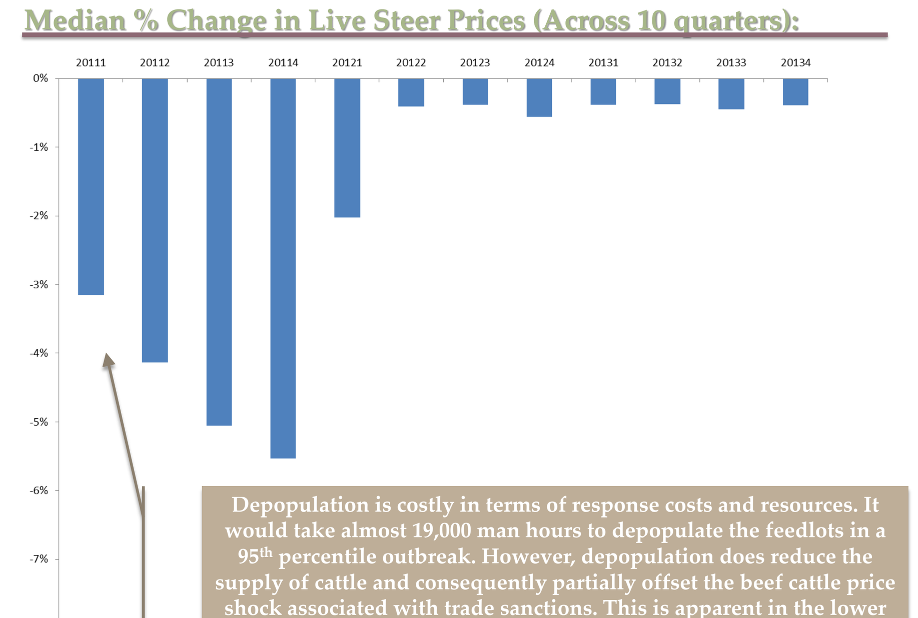
Economic consequences

Median: | 95th Percentile:

Producer Welfare Loss — $17.3 B ($ = $1B)

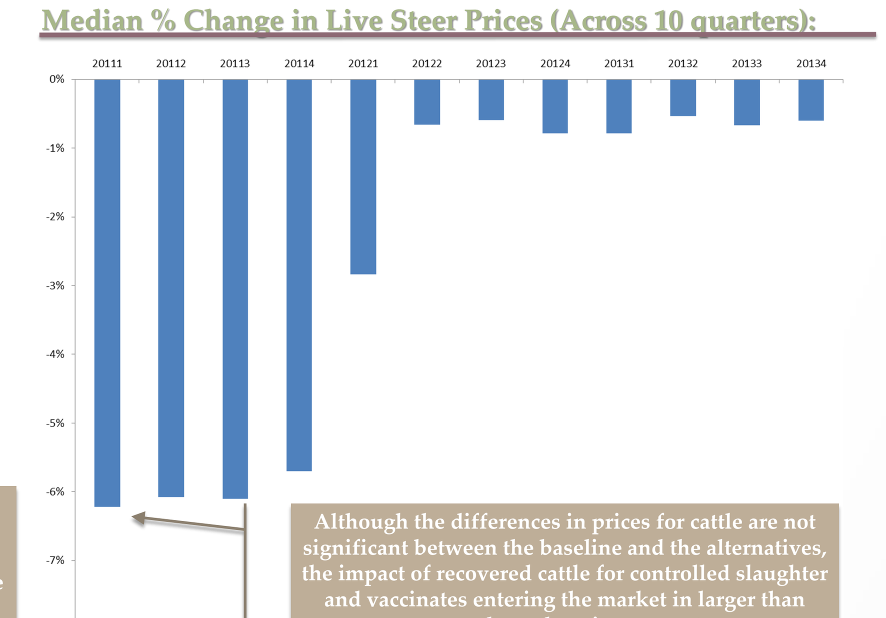
Alternatives 1 & 2 do not result in significantly different producer losses over the course of 12 quarters (were stochastic trade sanctions could extend as long as 10 quarters); however, producer welfare losses in the quarter in which the outbreak happens were 25% and 30% lower for Alternative 1 and Alternative 2 respectively due to the ability to sell animals immediately following when movement restrictions were lifted.

Median % Change in Live Steer Prices (Across 10 quarters):



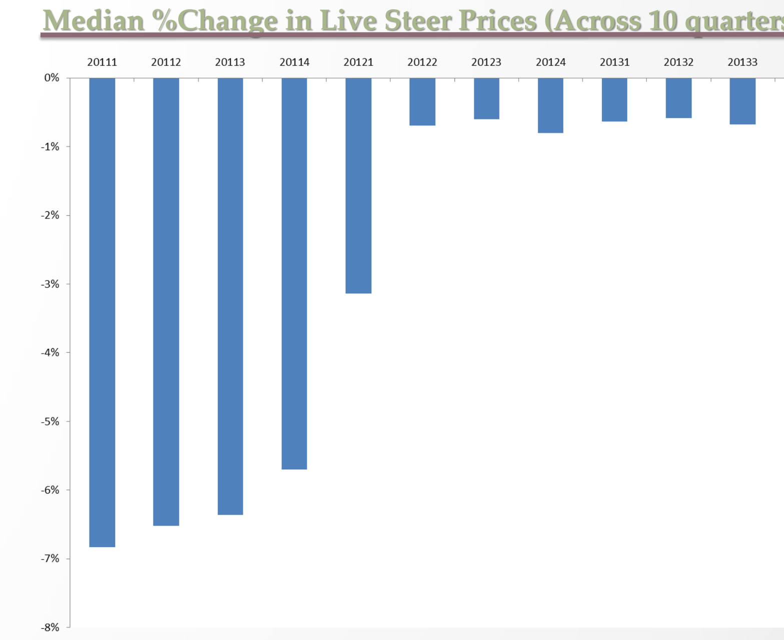
Depopulation is costly in terms of response costs and resources. It would take almost 19,000 man hours to depopulate the feedlots in a 95th percentile outbreak. However, depopulation does reduce the supply of cattle and consequently partially offset the beef cattle price shock associated with trade sanctions. This is apparent in the lower price declines in the first year as compared to Alternatives 1 and 2.

Median % Change in Live Steer Prices (Across 10 quarters):



Although the differences in prices for cattle are not significant between the baseline and the alternatives, the impact of recovered cattle for controlled slaughter and vaccinates entering the market in larger than normal numbers is apparent.

Median %Change in Live Steer Prices (Across 10 quarters):



CONCLUSIONS

- Epidemiologic modeling suggests that alternative control strategies for feedlots do not increase the severity of an outbreak, assuming adequate biosecurity. Feedlots will need strong biosecurity in order to allow for feed delivery and routine animal care.
- Alternative control strategies may increase the odds of a longer outbreak duration by 1 week or more.
- Under the baseline scenario, for the 95th percentile outbreak, it would take 19,000 man hours to depopulate, dispose of animal carcasses, and disinfect the feedlot. The alternatives using controlled slaughter would require less man power for response, assuming markets can be identified for the meat, but require a large number of trucks and slaughter capacity.
- Economic modeling results suggest that alternative control strategies for feedlots do not significantly increase or decrease producer welfare losses over the course of 12 quarters.
- Larger than normal supplies of cattle entering the supply chain due to controlled slaughter would exacerbate steer price declines since depopulation's effect on supply helps offset trade losses.
- The results in this May 2015 draft of the poster represent preliminary results that will be updated prior to the 2015 AAEA meetings.

ACKNOWLEDGEMENTS

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