

**Economic Analysis of Foreign Animal and Zoonotic Disease Policies**

DHS Priority Areas Addressed	<input checked="" type="checkbox"/> Prevention <input type="checkbox"/> Detection <input checked="" type="checkbox"/> Response <input type="checkbox"/> Recovery <input type="checkbox"/> Education/Risk Communication			
Proposal Section Addressed	Sections 5.1.3 and 5.4.2			
Investigators	UCD: Richard Howitt			
<b>Objectives</b>	<b>Deliverables</b>	<b>Progress Toward Deliverables</b>	<b>Percent Complete</b>	
To contribute to the development of a framework that unifies economic sector and regional analyses	Develop a three-county California model	The model was completed and validated against the simulation model (Project 1).	100%	
	Extend the three-county model to a California state model	The extension method started by identifying several candidate approaches that combined the simulation model (Project 1) and optimization model, which enabled the preservation of the stochastic and spatially explicit representation of premises.	20%	
	Complete the California model code and operation	The development process halted because the simulation model (Project 1) evolved further in preparation for the nation-wide version and is not yet completed.	0%	
To develop the capability to conduct risk-based analysis on how the incorporation of potential alternative foreign animal and zoonotic disease protocols affect the long-run expected cost of the total disease management and outbreak control system	Conduct a three-county risk analysis	Using the three-county model, vulnerability of the regional livestock economy to FMD outbreak was evaluated. In addition, alternative investment policies to prepare for a potential outbreak were evaluated based on the vulnerability.	100%	
	Conduct a state-level risk analysis	Due to the above mentioned reason, the task was not implemented.	0%	
To conduct analyses of strategic and operational options for scenarios regarding prevention, detection, response, and recovery using economic and other components of the Center’s modeling capability to evaluate alternatives at the strategic level and management levels	Conduct a three-county disease case analysis	Using the three-county model, optimal disease control strategies were analyzed. Potential impacts of limited carcass disposal capacity were also evaluated. Substitutability between investment in carcass disposal capacity and surveillance efforts were also quantified.	100%	
	Conduct a state-level disease case analysis	Due to the above mentioned reason, the task was not implemented.	0%	
To analyze the trade consequences of an outbreak of FMD in the form of trade barriers and product quality certifications on international trade and on inter-regional trade	Collect data to extend the Eckboir method	Preliminary import demand elasticities were estimated. World beef trade simulation model (BTM) is being calibrated.	40%	
	Analyze the California outbreak	Due to the above mentioned reason, the task was not implemented.	0%	
	Analyze California and Texas outbreak	Due to the above mentioned reason, the task was not implemented.	0%	

**Highlight for Research Briefs**

- Using the three-county optimal FMD control model, we analyzed the optimal preparation investment levels in terms of vaccine stockpile, carcass disposal capacity, and active surveillance.
- Using the same model, the value of information collection and model parameter estimation during an FMD epidemic were estimated.

**Interpretive Summary**

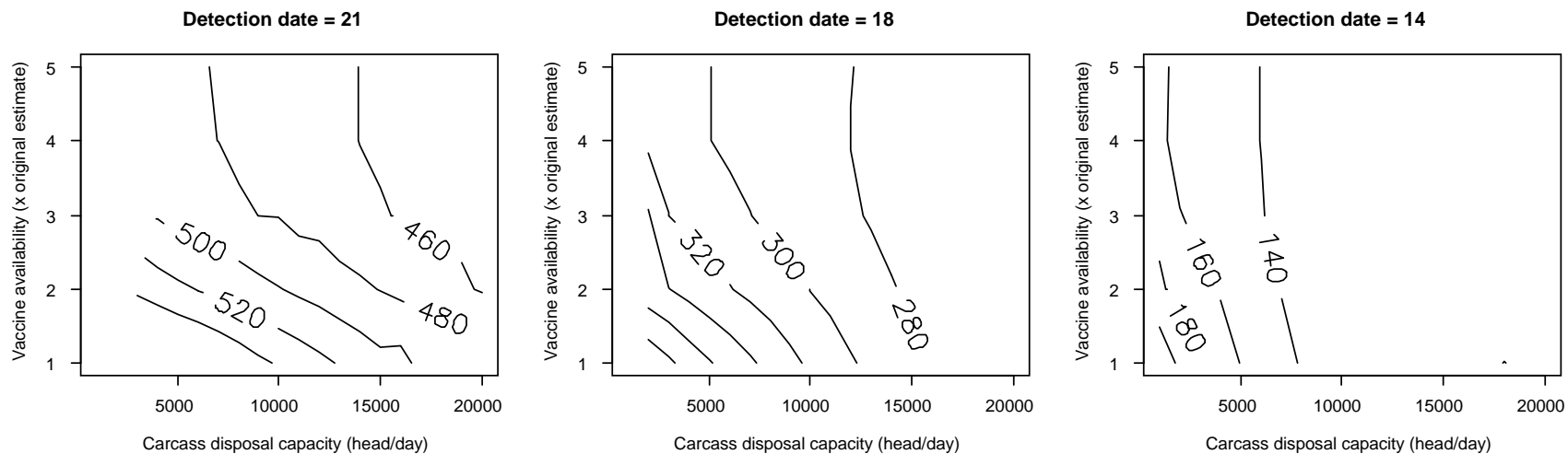
We have developed a dynamic optimization model of FMD control in a three-county region in California. The model, which solves for cost-minimizing FMD control strategies, was parameterized using the output generated by the simulation model developed by Project 1. In year 3, the

model was used to generate policy relevant output. First, the model was used to determine optimal investment levels in preparation for a potential FMD outbreak in the region. Second, the model was used to demonstrate cost-saving effects of timely collecting epidemic information (data) and more accurately estimating model parameters during an epidemic. We are currently preparing manuscripts, to be submitted to academic journals, based on the results of the two exercises.

## Results and Interpretations

In the exercise on optimal FMD preparation, we found that there is substantial substitutability among available control measures required to achieve a certain level of outbreak control. For example, the figures below show how certain levels of total costs can be achieved under different combinations of carcass disposal capacity and vaccine stockpile levels. Using the information and the information about the costs of investment, we estimated optimal investment levels for the region.

Figure 1. Iso-cost curves (\$million, index case = sales yard)



In the exercise on timely information collection and parameter estimation, we showed that maximum entropy estimation technique allows estimation of epidemic parameters sooner than traditional method can, thus allowing more timely control actions. We also show that data collection in the early stages of outbreak is important. Moreover, we find it important to update model parameter estimates as more data are collected, to improve model accuracy.

## Technology Transition

The method and data used in the three-county optimal FMD control model are detailed in “A dynamic, optimal disease control model for foot-and-mouth disease: I. Model description” by M. Kobayashi, T. Carpenter, B. Dickey, and R. Howitt, published in Preventive Veterinary Medicine, 79 (2007). Thus the method and data are publicly available. The program code (in GAMS language) is available upon request.

**Status of Funding**

We are under budget due to the inability to perform the state level analysis given the lack of state level model.