Information, Modeling, and Analysis – Project 12 Year 3 Annual Report

Economic Studies Regarding Comprehensive Decision Making for Agricultural Biosecurity

DHS Priority Areas Addressed	☒ Prevention	☐ Detection	☐ Response	☒ Recovery	☐ Education/Risk Communication
Proposal Section Addressed	Sections 5.1.3 and 5.4.1				
Investigators	TAMU: Bruce McCarl, David Bessler, Y. Jin, and Levan Elbakidze				

Objectives	Deliverables	Progress Toward Deliverables	Percent Complete
To contribute to the development of a framework that unifies economic sector and regional analyses, results of component biological science studies, information systems, and results from other models into a framework which can be used for the analysis of alternatives and options related to the intentional introduction of FAD-ZD	Develop regional livestock models	The costing module designed to interface with the regional epidemiologic model has been developed. Value of livestock herds and costs of control mechanisms are explicitly incorporated. The module has been adjusted to reflect the newly available data collected by Bo Norby et al. in high plains of Texas. This includes composition of herds, and resource availability for effective response measures.	90%
	Develop agricultural sector model with dynamic disease outbreak stochastic events in US	Stochastic model was developed and applied in a preliminary analysis of FMD outbreak in Texas. The model is used to examine balance of ex ante versus ex post control mechanisms. The transition of this framework onto linked economic-epidemiologic system is in the works.	55%
	Link to epidemiology and environmental models	The link between the economic costing module and the epidemiologic model remains manual. Files with data are manually transferred from epidemiologic to economic module. Work is under way on adapting this transfer to a SQL (Structured Query Language) based interface to allow remote and automatic data access.	55%
	UK FMD and BSE impacts and dynamic recovery	Additional work on the UK 2001 FMD versus 1996 BSE experience has been completed in 2006-2007. We replicate earlier results (done with monthly data) with weekly data. We find that for two years following the 1996 BSE event farm-level prices of cattle did not return to their pre February 1996 levels. The event, with linkages of BSE to human health, had long term negative consequences for the UK cattle (and beef) market. Results in a neighborhood of the February 2001 discovery of FMD, show that cattle, sheep, pig and poultry markets did recover to their pre-event price levels within twelve months of the event, suggesting that consumers did not associate long-term negative consequences of the event.	80%
	Prepare report on conceptual approach to modeling	Conceptual approach has been documented in several publications and manuscripts. See below.	60%
	Conduct literature review on economics of outbreak modeling	Review of relevant literature is part of several publications and manuscripts. See below. In addition, earlier work entitled , “The Economics of Agricultural Bio-security: An Interpretive Literature Review," originally by Elbakidze and McCarl, is being reworked to be submitted as a discussion paper to the International Journal of Risk Assessment and Management.	70%
To develop capability to conduct risk-based analysis on how the incorporation of potential alternative FAD-ZD protocols affect the long-run expected cost of the total disease management and outbreak control system	Develop stochastic regional livestock models	Two-stage stochastic modeling approach is used to study the balance of pre-event and post event mitigation actions. The economic cost module is being adjusted to allow for the two stage nature and process data to be available from the epidemiologic model.	40%
	Develop agricultural sector model with total system view and two-stage dynamic programming for risk-cost trade-off of FAD-ZD	Agricultural sector model (ASM) is being worked on to include the capability to analyze data from epidemiological models. The model reflects a total system view to include multiple commodity markets and trade. The model is currently being used worked on to perform multiple scenarios analysis of Rift Valley Fever outbreak in the US	40%

	Prepare report on conceptual approach to risk modeling in disease control context	The conceptual approach has been documented in various publications including a dissertation and a couple of manuscripts. In addition, the approach will be described in the report for Texas high plains project.	75%
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 strategy level as well as optimal allocation of efforts between event management levels	Conduct FMD economic case studies in Texas and California	Two studies have been published pertaining to FMD in Texas. One is published in the Journal of Agricultural and Applied Economics and addresses the balance of ex ante and ex post mitigation strategies pertaining to infectious animal disease outbreak in Texas. The second study has been published at the Journal of Agricultural and Resource Economics and addresses the benefits if animal tracing system under the scenario of FMD outbreak in Texas. In addition, a study is under way which incorporates separate epidemiologic and economic components to analyze the consequences of FMD introduction in high plains of Texas. Discussions are being held relative to California.	50%
	Conduct sensitivity analysis of damage/ response statement design for different diseases	The studies thus far indicate that balance of ex ante and ex post control mechanisms depend on the probability of disease outbreak, effectiveness and costs of control options, and disease spread rate. In addition, on going studies investigate the impacts of increased vaccine availability and enhanced surveillance.	45%
	Prepare report on Decision Support System integration for case studies	This is documented in "An economic cost module to a bio-security animal disease risk simulation" by P. Sherwell. In addition the process will also be documented in the report for the study of FMD outbreak in High Plains of Texas	35%
Participate in the study on the consequences of alternative carcass disposal methods examining economic consequences of alternatives and regulatory compliance.	Conduct literature review on economic effects of livestock diseases	This is discussed in two documents. One is "The Economics of Agricultural Bio-security: An Interpretive Literature Review," By Levan Elbakidze. The other is "Economic Issues of Agricultural Bio-security" by Elbakidze, jin, and McCarl.	65%
	Model actual impacts of FMD outbreak on UK agricultural and food economy	Discussed above	80%
	Model simulated impacts of FMD on US agricultural and food economy	Impacts of potential FMD outbreak in Texas are discussed in "Animal disease pre event preparedness versus post event response: When is it economic to protect?" by Elbakidze and McCarl and in "Economic benefits of animal tracing in the cattle production sector" by Elbakidze. Work has began to model the economic impacts on the agricultural sector of the whole US. The approach is being tested with Rift Valley fever scenarios.	20%
Examine the effects of outbreaks and released information on the meat and milk demand and on the dynamic recovery of demand.	Build dynamic model and impulse responses of alternative information and trade practices	See report by Economists at UC Davis, headed by dr. Richard Howitt	

Highlight for Research Briefs

- The cost module has been developed for evaluation of regional economic consequences of infectious animal disease (FMD) introduction. The model calculates regional costs within livestock industry associated with disease outbreak and its mitigation efforts. The module has been updated and adjusted to include the newly available data from survey by Dr. Bo Norby.
- The study of the effectiveness of animal tracking system as a pre-event measure of reducing vulnerability of cattle industry towards infectious animal disease outbreak has been published in the *Journal Agricultural and Resource Economics*. The results show that animal ID system, Capable of tracking animal movements within 48 hours, could be extremely useful under the scenario of a disease outbreak. However, the cost effectiveness of investing in such system depends on the probability of disease outbreak, effectiveness of such system and severity of disease outbreak.
- Agricultural Sector Model (ASM), which incorporates multi regional, international, multi-commodity market interactions is being adapted

to allow for a total analysis of impacts on agricultural industry. The initial efforts in this direction have been applied to the introductions of Rift Valley Fever scenarios in the US in collaboration with Dr. David Hartley, Project 2.

- Earlier results pertaining to the analysis of FMD and BSE outbreaks in the UK were replicated using a weekly data. Results suggest that for two years following the 1996 BSE event farm-level prices of cattle did not return to their pre February 1996 levels. On the other hand, after the discovery of FMD in February 2001 cattle, sheep, pig and poultry markets did recover to their pre-event price levels within twelve months of the event.
- A preliminary analysis has been conducted to investigate the relationship between reducing the inter flock contact rate and reducing the lengths of latent and symptomatic periods in the context of spread of Avian Influenza across backyard flocks.

Interpretive Summary

On going efforts under this project can be summarized as follows:

- The analysis of the balance of ex ante and ex post mitigation actions. Two publications have been generated on this topic. One examines the balance of ex ante periodic animal testing and ex post culling of infected herds and herd with direct contact with the infected herds and is published in the Journal of Agricultural and Applied Economics. The second publication examines the cost effectiveness of implementing animal tracking system capable of tracing animal movements within 48 hours and is published in the Journal of Agricultural and Applied Economics.
- Ex ante vs. ex post mitigation analysis is also being applied to the linked epidemiologic-economic modeling framework, where the costing module for regional livestock industry is being used for the economic analysis. The scenarios in the epidemiologic model are being designed to account for pre and post event mitigation options and strategies.
- Agricultural Sector model (ASM) is being expanded to allow the analysis of the economic implications of infectious animal disease introduction into the US on agricultural sector of the economy. The model includes several US regions, as well as international trading partners, numerous agricultural commodities with corresponding producer, processor, and consumer factors. The model is price endogenous meaning that prices are determined as combinations of corresponding supply and demand curves taking into account substitute and complement products. The first applications of the model are being processed in the context of Rift Valley Fever introduction into the US.
- A poster has been presented at the annual meeting of the American Agricultural Economics Association entitled “Critical Components of Preparedness and Response for Avian Flue Mitigation within the Poultry Sector”. The poster demonstrated a methodology for modeling spread and mitigation of Avian influenza across commercial poultry sector of Texas.

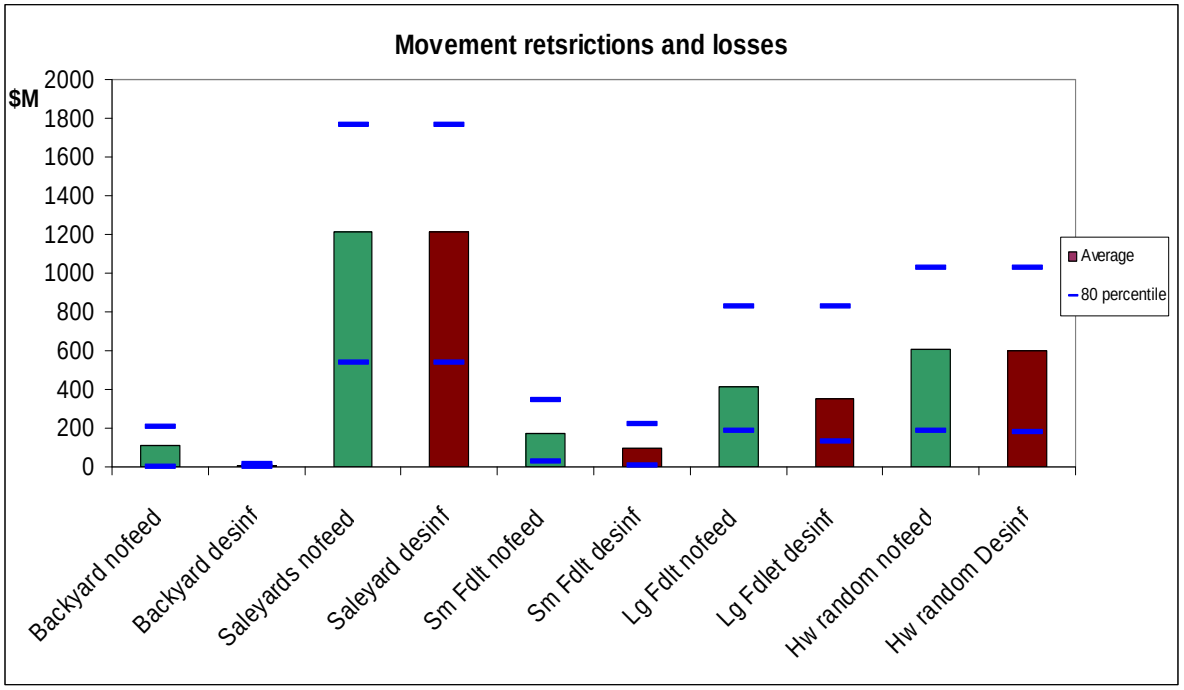
Results and Interpretations

- Two publications have been generated pertaining to the balance of ex ante and ex post mitigation efforts.
    - One examines the balance of ex ante periodic animal testing and ex post culling of infected herds and herd with direct contact with the infected herds. The results show that for slow spreading disease the probability at which testing becomes desirable is lower than corresponding probability for fast spreading disease. The reason is that effectiveness of testing decreases as the spread rate increases. In other words, relatively more frequent tests are need to be conducted under fast spreading diseases, than under slow

spreading disease, to significantly decrease number of infected herds

- The second publication examines the cost effectiveness of implementing animal tracing system capable of tracing animal movements within 48 hours. While animal ID system could be extremely effective if infectious animal disease hits cattle industry, both studies show that cost effectiveness of investing in such pre event mechanisms depends on such factors as probability of occurrence, event severity, and relative effectiveness of the pre events system. The results show that animal ID system which would decrease animal traceability form even 8 day to 2 days would save about 45% of the value of Texas cattle industry if an outbreak of an infectious animal disease were to take place in Texas.

- Preliminary runs have been completed for the linked-epidemiologic modeling framework. The runs have been used to do a preliminary analysis of quarantine policies under the introduction of FMD in high plains of Texas. Specifically, we used the model to compare the losses under the policy where no feed truck are allowed to enter the quarantine zone, and losses under the policy where cleaned feed trucks (at a fixed costs per head) are allowed to enter the quarantined premises. The preliminary results (figure 1) show that while the policy formulation is important for some scenarios, for other scenarios, where the disease gets out of control, quarantine regulation makes little difference. This is an expected result since when the disease gets out of control not many premises which are not infected end up quarantined. This modeling framework is being used to analyze the implications of early detection strategies and increased and earlier vaccine availability.



Legend
Green bar – No feed trucks
Red Bar – Disinfected trucks
Blue lines – 80th percentile of losses

Figure 1. Losses under different FMD introduction scenarios and different quarantine policies

- The results of the preliminary analysis of mitigating Avian Influenza within backyard flocks of the poultry sector indicate that efforts to reduce the lengths of latent and symptomatic periods and efforts to control inter flock contact rates generally function as substitutes. The results also show that as efforts to cut the length of the latent period increase, the control of inter flock contact rates is more concentrated on symptomatic flocks rather than latent flocks. On the other hand, as efforts to cut the length of the symptomatic period increase, the control of inter flock contact rate is more concentrated on latent flocks rather than symptomatic flocks.

Technology Transition

- Engagement with the TCFA (Texas Cattle Feeders Association) is nearing its final stages. A report will be produced in collaboration with the epidemiologists, headed by Dr. Ward, which will summarize the efforts pertaining to epidemiologic and economic analysis of Foot and Mouth Disease introduction and control in the high plains of Texas. Various strategies will be discussed including enhanced surveillance, early detection, and increased vaccine availability.
- Engagement with NBACC contractor Battelle is in progress. The report on the Economic implications of Rift Valley Fever outbreak in the US will be generated. The analysis is under way for multiple scenario analysis using Agricultural Sector Model which includes multiple regional agricultural commodity markets in the US and rest of the world (ROW).

Status of Funding

Ongoing.

Publications, Reports and Presentations Associated with Project

PUBLICATIONS AND PRESENTATIONS

Journal Articles

Elbakidze L., "Economic Benefits of Animal Tracing in the Cattle Production Sector" *Journal of Agricultural and Resource Economics*, 32, 1, (April 2007):169-180.

Elbakidze L. and B. McCarl, "Animal Disease Pre Event Preparedness versus Post Event Response: When is it Economic to Protect?" *Journal of Agricultural and Applied Economics*. 38, 2, (August 2006):327-336

Elbakidze, L., "Modeling of Avian Influenza Mitigation Policies within Poultry Sector" under review at the Journal of Agricultural and Resource Economics (JARE)

Invited Papers

Elbakidze, L., and B.A. McCarl, "Mitigation of Infectious Animal Disease Outbreaks: Economic Issues and Modeling," Presented at meeting of NC-1016 Regional Research committee and AAEA FAMPS entitled Bio-terrorism and Natural Disasters: Market and Policy Responses, March 22-23, Washington D. C, 2007.

McCarl, B.A., and L. Elbakidze, "Economic Evaluation of Preparedness, Response, and Recovery strategies," Presented at the DHS Research and Education Summit, Washington, March 15-16, 2007.

Elbakidze, L., and B.A. McCarl, "Bio-Security and the US Livestock Sector: Trading off Prevention and Response," Invited paper Meetings of Southern Agricultural Economics Association, Orlando, 2006.

Elbakidze, L., B.A. McCarl, M.A. Ward, and J.B. Carey, "Modeling and Economic Evaluation of Effectiveness of Avian Influenza Mitigation Options," ERS, USDA, Washington, D.C. October, presented at Program of Research on the Economics of Invasive Species Management, 2006.

Professional Meetings Presentations

Elbakidze L., "Economic Benefits of Animal Tracing in the Cattle Production Sector" Western Agricultural Economics Association Annual Meetings, Portland OR, July 2007

Bessler, D.A. "The UK FMD Experience and Challenges of Re-Establishing Domestic Markets," National Institute of Animal Agriculture, Annual Conference Louisville, Kentucky, April 6, 2006.

Elbakidze L, "Determinants of Preparedness to Infectious Animal Disease Introductions" Annual Meetings of Southwestern Economics Association. San Antonio, April 2006

Elbakidze, L., and B.A. McCarl, "Bio-Security and the U.S. Livestock Sector: Trading off Prevention and Response," Invited paper Meetings of Southern Agricultural Economics Association, Orlando, 2006.

Elbakidze L, "Determinants of Preparedness to Infectious Animal Disease Introductions" Annual Meetings of Southwestern Economics Association. San Antonio, April 2006

Jin, Y., and B.A. McCarl, "Animal Disease Related Pre-event Investment and Post-event Compensation: A Multi-agent Problem," Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meetings, Long Beach, California, July 23-26, 2006.

Jin, Y., W. Huang, and B.A. McCarl, "Economics of Homeland Security: Carcass Disposal and the Design of Animal Disease Defense," Presented at Southwestern Economics Meetings, Wednesday, March 1 to Saturday, March 4, 2006 Oklahoma City, OK, 2006.

Posters

Elbakidze, L., and A. Edgendewe-Mondzozo, "Critical Components of Preparedness and Response for Avian Flue Mitigation within the Poultry Sector", Poster presentation at the Annual Meetings of American Agricultural Economics Association, Portland, OR, July 2007

Gao, Q., Y.H. Jin, and B.A. McCarl, "Animal Carcass Disposal under a Trial Event," Poster at DHS Research and Education Summit, Washington DC, March, 2007.

Hu, R., D.A. Bessler, B.A. McCarl, and Y.H. Jin, "Impact of Animal Disease-related Trade Disruption on the US Beef Market," Poster at DHS Research and Education Summit, Washington, DC, March, 2007.

Huang, W., D.A. Bessler, Y.H. Jin, and B.A. McCarl, "Dynamic Relationships among US Stock Prices of Meat and Egg Producers and Processors during Avian Influenza Events wash," Poster at DHS Meeting, Washington, D.C., May, 2007.

Organized Sessions at Meetings:

Elbakidze, L. "Agroterrorism: Threats, Vulnerabilities and Mitigation" Economics Session at Southwestern Social Sciences Conference in San Antonio, Texas, April 2006.

Moss, C., and B.A. McCarl, "Bio-Security, Diseases, and Invasive Species: Implications of Bioterrorism for Agriculture," Organizers of Invited paper Session at Southern Agricultural Economics Association Meetings, 2006.

Presentations to Interested Groups

Jin, Y.H., W. Huang, and B.A. McCarl, "Economics of Homeland Security: Carcass Disposal and the Design of Animal Disease Defense," Abstract of paper to Southwestern Economics Meetings, 2006.

Draft Journal Articles

Boadu, F.O., and B.A. McCarl, "Do Institutional and Transaction Cost Considerations Rule out Ocean Dumping of Biologically-Contaminated Livestock Carcasses?," 2007.

Elbakidze, L., Y.H. Jin, and B.A. McCarl, "Biosecurity Assurance in a Threatening World: Challenges, Explorations, and Breakthroughs," Proposed paper for a journal special issue of International Journal of Risk Assessment and Management (IJRAM)., 2007.

Jin, Y.H., W. Huang, and B.A. McCarl, "Animal Disease Related Carcass Disposal: Economic Issues and Interactions with Disease Management," 2007.

Jin, Y. H. and B.A. McCarl, "Animal Disease Related Pre-event Investment and Post-event Compensation: A Multi-agent Problem," Department of Agricultural Economics, Texas A&M University, 2006.

Unpublished Proceedings

Huang, W., D.A. Bessler, Y.H. Jin, and B.A. McCarl, "Dynamic Relationships among US Stock Prices of Meat and Egg Producers and Processors during Avian Influenza Events," Presented at Southwestern Economics Association, Albuquerque, NM, March, 2007.

Jin, Y.H., and B.A. McCarl, "Animal Disease Related Pre-event Investment and Post-event Compensation: A Multi-agent Problem," Selected paper presented at the Annual Meeting of American Agricultural Economics Association, Long Beach, CA, July, 2006.

Jin, Y.H., Q. Gao, B.A. McCarl, and M.A. Ward, "Costs of Contaminated Animal Carcass Disposal under Trial Events," Presented at Carcass Disposal Conference, Baltimore MD, December, 2006.

Jin, Y.H., W. Huang, and B.A. McCarl, "Economics of Homeland Security: Carcass Disposal and the Design of Animal Disease Defense," Presented at Southwestern Economics Association Meeting, San Antonio, April, 2006.

Moss, C., and B.A. McCarl, "Bio-Security, Diseases, and Invasive Species: Implications of Bioterrorism for Agriculture," Organizers of Invited paper session southern meetings, 2006.

Outreach Presentations

McCarl, B.A., J.H. Jacobs, Y.H. Jin, and R. Srinivasan, "Animal Disease and Carcass Disposal," DHS News item, 2006.

McCarl, B.A., L. Elbakidze, and Y.H. Jin, "Preparedness Investments versus Response Expenditures for Animal Disease Mitigation," DHS news item, 2006.

Project reporting

McCarl, B.A., "Economic work within FAZD Basic Directions," sent to adam rose USC, 2007.

McCarl, B.A., and L. Elbakidze, "Overview of Procedures used in Economics part of Rift Valley Fever Analysis," DHS FAZD report, 2007.

McCarl, B.A., and L. Elbakidze, "Vulnerability Assessment Animal Disease," FAZD Rift Valley Meeting, 2007.

Angerer, J.P., B.A. McCarl, and M.A. Ward, "Information, Modeling and Analysis Thematic Summary," Presented at FAZD Annual Meeting, August, 2006.

Elbakidze, L., and B.A. McCarl, "Economic efforts under FAZD on High Plains," Presentation to DHS-NBACC Visit To FAZD Center, 2006.

Elbakidze, L., and B.A. McCarl, "General Description of an Economic Costing Module for Damage Estimation under an Animal Disease Outbreak," FAZD, 2006.

McCarl, B.A., D.A. Bessler, L. Elbakidze, and Y. H. Jin, "Spring 2006 Quarterly report on Economic Studies Regarding Comprehensive Decision Making for Agricultural Biosecurity," 2006.

Proposals

Boadu, F.O., and B.A. McCarl, "DHS Homeland Security Career Development Proposal: Developing Seamless Education and Career Development Fellowship Program," 2007.

Nipp, T., L. Elbakidze, D. Hartley, and B.A. McCarl, "NCFADD Supporting DHS/NBACC FAZD," FAZD contract report for presentation to external advisory committee meeting, 2007.

Clarke, N.P., L. Elbakidze, D.M. Hartley, B.A. McCarl, T. Nipp, C.J. Peters, and R. Srinivasan, "Statement of work: Animal Disease Consequence Modeling of Rift Valley Fever," Proposal to NBAC (funded), 2006.

Elbakidze, L., B.A. McCarl, and M.A. Ward, "Modeling and Economic Evaluation of Effectiveness of Avian Influenza Mitigation Options prop," Proposal to USDA, ERS, PREISM, 2006 (funded).

McCarl, B.A., E. Jones, V. Salin, and Y.H. Jin, "PHD 2006 National Needs Graduate Fellowship Proposal: : Marketing and Management: Biosecurity in the Agribusiness and Food Supply Chain," proposal to USDA NRCEES now accepted, 2006.

Elbakidze L., R. Nayga, “Marketing study of traceable/identity preserved Texas beef products”, Federal-State Marketing Improvement Program, USDA, 2006, Declined