Information, Modeling, and Analysis – Project 6 Year 3 Annual Report

Improving the Epidemiologic Engine of Current Foot-and-Mouth Disease Models

DHS Priority Areas Addressed	☒ Prevention	☐ Detection	☒ Response	☐ Recovery	☐ Education/Risk Communication
Proposal Section Addressed	Sections 5.1.2 and 5.3.3				
Investigators	TAMU: Bo Norby and Morgan Scott				

Objectives	Deliverables	Progress Toward Deliverables	Percent Complete
To assist in improving the epidemiologic engine of the current FMD models developed at UCD to apply to larger geographical areas and models that can be used as platforms to develop methods to apply to the model at varying levels of scale from farm to national scale	Determine herd density and distribution	Available information concerning livestock numbers, farm numbers, livestock movements, and biosecurity was determined from USDA NASS and NAHMS studies. Farm level livestock numbers, intra-herd densities, and inter-herd movements were determined from livestock producer surveys. Similar county level livestock data was collected from county Extension agent surveys. Veterinarians and sale barn managers were also surveyed in order to obtain additional information on direct and indirect contact rates. Results are presented in the technical report: "Herd Characterization in the Uvalde Study Area", and Dr. Dominguez's Master thesis: "Characterization of livestock herds in extensive agricultural settings in Southwest Texas" (2007).	100%
	Complete characterization of herd distribution in Uvalde study area	Available data from USDA, NASS and NAHMS sources, relevant to modeling efforts, were summarized for the study area. Livestock densities, distributions of livestock types on premises, and movements of animals in terms of contact rates and distances traveled were summarized from data obtained through livestock producer surveys. Surveys of county Extension agents were summarized to obtain county-level observations of livestock densities, distributions and movements. Surveys of veterinarians were used to refine the frequencies and distances traveled between premises for indirect contacts. Auction barns were the primary means for marketing of animals in the study area. Results are presented in the technical report and the Master thesis.	100%
	Test various methods of herd characterization in UCD FMD model	We are currently working with collaborators at UC Davis to test the effect of low livestock density, multiple livestock types, and seasonal variation in contact rates on the spread of FMD. Carry-over funds will be needed to complete this specific deliverable.	90%
	Prepare report on findings of herd sensitivity tests	In year two, a preliminary technical report was presented to modelers. Based on feedback, revisions to the data analysis were made and a final report regarding livestock density, distribution and contact rates has been submitted. Results of sensitivity analysis will be appended as they come available.	90%
To assist in developing an epidemiologic simulation environment capable of accommodating FAD-ZD beyond FMD	Define the premise concept relative to epidemiological response in modeling environments	An algorithm to distribute premises based on size of human population centers was developed in year one and refined in year two.	100%

	Characterize known premises and virtual premises in Uvalde study area	Geocoded premises boundaries were used to characterize premises based on acreage and the distance to the nearest human population center (city). Collaborators at the Texas A&M Spatial Sciences Lab added land use data to further characterize premises in terms of suitability for livestock production. Data from livestock producer surveys were used to describe livestock premises in terms of acreage, borders, land cover, and water availability. Results for this deliverable are presented in the technical report for the Uvalde study area and the Master thesis.	100%
	Conduct sensitivity analysis on premise representation and size using the UCD FMD model in the Uvalde study area	The number of premises reported by USDA NASS was used to compare the spatial distribution of premises based on a completely random assignment to a restricted assignment based on the land use classification. The sensitivity analysis is on-going.	90%
	Prepare report on findings of premise representation methods and implications on model design and disease transmission	Descriptions of livestock premises in the area were included in the previously mentioned technical report. A poster presentation regarding the distribution of premises in relation to human demographic centers was presented at the International Symposium on Veterinarian Epidemiology and Economics in August, 2006. A formal report in conjunction with the previous objective will be prepared following completion of the sensitivity analysis.	90%
To assist in improving the epidemiologic engine of the current FMD models developed at UCD to apply to larger geographical areas and models that can be used as platforms to develop methods to apply to the model at varying levels of scale from farm to national by focusing on an area of highly intensified livestock production interspersed with extensive livestock management operations	Determine herd density and distribution	In year two, the project objectives were expanded to include intensive and extensive livestock industries in the High Plains of Texas. Hence a substantial portion of our efforts were moved from the Uvalde project to the High Plains project. For the High Plains study area, disease transmission nodes were determined for cattle and swine industries in collaboration with industry leaders, extension personnel, and area academicians. Interviews were conducted with feedlot, dairy, and swine farm managers. Contact information for cow/calf and small ruminant producers was obtained from USDA-FSA in year three. We will contact the cow-calf producers by mail-out surveys during the fall of 2007. When completed, the cow-calf data on densities and contact rates will be added to the High Plains technical report.	80%
	Complete characterization of herd distribution in High Plains study area	Data have been compiled from the USDA NASS census for the eight counties in this study area. Texas Cooperative Extension agents, veterinarians, feedlot managers, dairy managers, and swine farm owners were interviewed using survey instruments similar to the mail-out surveys used in the Uvalde study area. As described above, cow-calf surveys will be completed during the fall of 2007. The results from the feedlot, dairy, and swine surveys are presented in the technical report: “Herd Characterization in the High Plains Study Area”	80%
	Test various methods of herd characterization in UCD FMD model	Data and results on intra-herd animal densities and inter-herd contact rates were made available to the TAMU and UCD modeling groups and to researchers at the Lawrence Livermore National Laboratory in California..	100%
	Prepare report on findings of herd sensitivity tests	A technical report describing results from the High Plains study is attached to this report. The report will be updated with results on herd density and distributions, as well as contact rates for cow-calf premises when these data become available.	90%

Highlight for Research Briefs

- We were able to garner great support from many industry groups:
  - Texas Cattle Feeders Association
  - Texas Association of Dairymen
  - Texas Pork Producers Association
  - Texas Cooperative Extension Service
  - Veterinarians

    - Auction barn mangers
    - Livestock producers
- Presentations about the findings and methodologies employed in this study were presented at local, state, national, and international meetings.
    - Dominguez, BJ., Norby, B., Scott, HM. Characterization of Livestock Herds and Contact Rates in Extensive Agricultural Settings. Oral Presentation. International Society for Veterinary Economics and Epidemiology Symposium. August 6-11, 2006. Cairns, Australia.
    - Dominguez, BJ., Norby, B., Jacobs, JH., Angerer, J., Scott, HM. The Premise of Premises. Poster Presentation. International Society for Veterinary Economics and Epidemiology Symposium. August 6-11, 2006. Cairns, Australia.
    - Loneragan, SJ., Norby, B., Dominguez, BJ. Survey of livestock movements and contacts for the simulation of spread of foot-and-mouth disease in the Texas Panhandle. Conference of Research Workers in Animal Diseases. December 3-5, 2006. Chicago, IL.
    - Dominguez, BJ., Norby, B., Scott, HM., Posey, D. Characterization of Livestock Herds in Southwest Texas. Poster Presentation. Texas A&M Agriculture Conference. January 8-10, 2007. College Station, TX.
    - Loneragan, SJ., Norby, B., Dominguez, BJ., Survey of livestock movements and contacts for the development of a regional foot-and-mouth disease epidemic model. Poster Presentation. Texas A&M Agriculture Conference. January 8-9, 2007. College Station, TX.
    - Dominguez, BJ., Norby, B., Scott, HM., Posey, D. Characterization of Livestock Herds in Southwest Texas. Poster Presentation. Texas A&M College of Veterinary Medicine and Biomedical Sciences Graduate Student Association Symposium. April 23, 2007. College Station, TX.
- One journal articles presenting resulting from the Uvalde study is in preparation for publication
- Brandon Dominguez completed a Master thesis based on data from this project.

Interpretive Summary

A central register of cattle and other livestock producers were not available for the state of Texas. Hence, close collaboration was needed between members of the project team, other groups within the FAZD center, state agencies, and industry groups. Intra-herd livestock densities and distributions were determined for extensive and intensive agricultural settings in Texas. In addition, contact rates for livestock leaving premises and livestock arriving at premises were determined direct inter-herd contact rates. These data were collected in order to advance modeling efforts in areas of extensive and intensive agriculture in Texas. In the extensive agricultural area (Uvalde), we determined that close to 40% of all ranchers/producers had two or more livestock types on their premises. In addition, there were significant seasonal differences in contact rates within herd types. Multiple livestock species on the same premises and seasonal variations in contact rates were not seen for intensively managed operations in the High Plains. To our knowledge, this is the first study in the U.S. focusing on herd densities and contact rates in extensive agricultural settings as well as intensive feedlot settings. The variable aggregation of livestock types on premises and seasonal variability in contact rates may affect the speed with which a FAD spread in extensive agricultural settings. Ancillary industries, such as auction barns, veterinarians, and county Extension agents also provided estimates of the herd-level data needed for the various modeling efforts in extensive as well as intensive areas. Results from this project are being used in support of infectious disease, transportation, and economic models. Sensitivity analyses of various methods to spatially assign livestock herds are ongoing.

Results and Interpretations

In the Uvalde study area, 528 surveys were mailed to livestock producers. Twenty-two (4.4%) had addresses which were no longer valid, 35 (6.6%) no longer had livestock, and 51 (9.6%) declined to participate. A total of 156 (33.2%) general surveys were completed. Approximately 44% of producers had more than one livestock type on their premises. The number of livestock types per premises ranged from one to five with a median of 1 and a mean of 1.7. There were 22 combinations of livestock types with one to 60 premises represented per combination. All producers that responded to the general survey, except one, received livestock type specific surveys based on the livestock types they indicated on the general survey. Eighty-seven of 155 (56.1%) producers returned 125 livestock type specific surveys. Ten select livestock-type combinations, which represented five individual livestock types and five combinations of two or more livestock types, represented 91.7% of all of the premises participating in the study. The 10 combinations were: beef cow/calf only, stocker cattle only, cattle on feed only, small ruminants only, high-fenced deer and exotics, beef cow/calf with stocker cattle, beef cow/calf with stocker cattle and cattle on feed, beef cow/calf with stocker cattle and small ruminants, beef cow/calf with small ruminants, and beef cow/calf with high-fenced deer and exotics. Our study showed that there is frequently more than one livestock type on one premises, and because all the different livestock types included in the study are susceptible to FMD, these conditions may affect how FMD spread if it is introduced in Texas.
Additionally, five of 11 (45.5%) veterinarians, three of seven (42.9%) auction barn managers, and all nine county agents in the area responded to surveys.

We also determined the movement of animals and people between premises. We assumed that any movement of animals from one premises to another within a month resulted in one contact for that month. Follow-up telephone interviews supported this except for stocker cattle premises where the number of contacts per month occasionally may be higher. For direct contacts (movement of live animals), there was a significant month to month variation for cow/calf and small ruminant premises. Direct contacts were highest in October and lowest in February. There was little month to month variation in indirect contact rates.

In the High Plains study area, 34 out of 70 (48.6%) feedlot managers, 21 of 46 (45.6%) dairy managers, and 16 of 42 (38.1%) of swine farm owners participated in the study. In this study area, there was only one livestock type per premises. In collaboration with industry leaders, feedlots were divided into six groups based on production type (ownership and type of cattle fed). The production type categories were: company owned cattle, customer owned cattle, stockholder owned cattle, back grounding, yearling pasture, and dairy calf raiser. Few feedlots had 100% of any one type of cattle. For modeling purposes, feedlots were classified based on the predominant feedlot type, but several feedlots were equally divided between company owned and customer owned cattle. In order to compare results to other studies, feedlots, dairies, and swine farms were additionally classified based on the number of animals on the premises. Results from the High Plains study area showed that there was little to no seasonal variation in contact rates, especially for feedlots and dairies. All eight county Extension agents in the study area and six of 18 (33.3%) veterinarians responded to the surveys mailed to them. Data collection on cow-calf operations in the High Plains study area is on-going.

For both project areas, producers provided information regarding the land cover and the borders of their premises. Livestock premises were most commonly bordered by other livestock premises. This information may aid in modifying how premises can distributed spatially when the exact location is unknown. Collaborators at the Spatial Sciences Laboratory, TAMU have developed software code to spatially distribute premises according to land cover. Additionally, we have developed an algorithm to distribute premises based on acreage in relation to human population centers.

Technology Transition

Results on contact rates and distances travel by livestock obtained from the Uvalde and/or the High Plains studies have been provided to the infectious disease modeling groups at Texas A&M University and UC Davis, and to the Lawrence Livermore National Laboratory.

One manuscript based on data and results from the Uvalde study area is in preparation for submittal to the American Journal of Veterinary Research.

Status of Funding

Approximately $8,000 for this project will not have been spent by August 31, 2007. We request a no cost extension to finish the sensitivity analyses for the Uvalde and High Plains study areas, as well as the cow-calf survey in the High Plains.

List of appendices:

- **A. Uvalde study**
  - **a. Technical report**
  - **b. MS Thesis by Dr. Brandon Domingues**
  - **c. Posters/presentations**
  - **d. Posters/presentations**
- **B. High Plains study**
  - **a. Technical report**
  - **b. Technical report addendums**
  - **c. Posters/presentations**