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Program Name:

Global Food Security: Minimizing Losses

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Non-Technical Summary

Emerging diseases of socio-economic importance have food security, perceived food safety, and domestic and international trade implications for the marketing of animals or animal products. Understanding the human behavioral dimensions of the introduction, spread, identification, reporting, and containment of new, emerging, and foreign pests and diseases of livestock is critically important for developing effective strategies to sustain a productive, profitable, and secure food animal sector. Experts in animal science and veterinary medicine, agricultural economics, public policy, anthropology, adult education, and risk communication come together to lead this inter-disciplinary applied research and outreach project focused on enhancing biosecurity practices and strategies to reduce the impact of incursions of new, emerging, or foreign pests or diseases of dairy, beef, and swine. Through engagement with project activities, stakeholders in U.S. dairy, beef, and pork production will be encouraged to implement practices and policies that collectively reduce the impact and threat of new, emerging, and foreign pests and diseases to the nation's meat and milk supply. This proposal directly addresses **Priority Area A5152 within the Food Security Challenge Area--Animal Health and Production and Animal Products**. Educational resources, "games", and messages developed and tested during the project will be made available beyond the end of the funding period through learning object repositories and an innovative web portal.

Accomplishments

Major goals of the project

Overall Goal: The activities and outputs of this project will facilitate the development and adoption of practices and policies that collectively reduce the impact of new, emerging and foreign pests and diseases to domestic production of cattle, swine and small ruminant foods and byproducts.

The following objectives will guide the activities of this CAP:

Objective 1: Characterize determinants of behavior of stakeholders at critical control points where application of practices or protocols can prevent (or reduce the impact of) incursions of pests and diseases of cattle, pigs and small ruminants.

Objective 2. Determine economic attractiveness of solutions that enhance biosecurity.

Objective 3. Determine most effective communication strategies (message tactic and wording, channels, and sources).

Objective 4. Integrate disease characteristics, human risk perception and socio-economic influences on behavior in a simulated "game" environment.

Objective 5. Develop educational and outreach materials and methods that lead to measurable changes in attitude and behaviors at critical control points in cattle, swine and small ruminant production systems.

What was accomplished under these goals?

Emerging diseases of socio-economic importance have food security, perceived food safety, and domestic and international trade implications for the marketing of animals or animal products. Understanding the human behavioral dimensions of the introduction, spread, identification, reporting, and containment of new, emerging and foreign pests and diseases of livestock is critically important for developing effective strategies to sustain a productive, profitable and secure food animal sector.

Experts in animal science and veterinary medicine, agricultural economics, public policy, anthropology, adult education and risk communication have come together to lead this inter-disciplinary applied research and outreach project focused on enhancing biosecurity practices and strategies to reduce the impact of incursions of new, emerging or foreign pests or diseases of dairy, beef and swine. Through engagement with project activities, stakeholders in U.S. dairy, beef and pork production will be encouraged to implement practices and policies that collectively reduce the impact and threat of new, emerging and foreign pests and diseases to the nation's meat and milk supply. Our first-year activities have focused on modeling the pork production chain and understanding the impact of porcine epidemic diarrhea virus, a recent emerging disease in the swine sector.

Objective 1: Characterize determinants of behavior of stakeholders at critical control points where application of practices or protocols can prevent (or reduce the impact of) incursions of pests and diseases of cattle, pigs and small ruminants.

An expert interview research protocol was developed and received IRB approval at the University of Vermont and University of Central Florida. The protocol includes two interview guides, one for risk communication strategy assessment, and the other for the SEGS lab agent-based modelling calibration. The protocol included detailed information on the hog industry collected from Co-PIs and Advisory Committee members at the November meeting in Chicago and thereafter. Approval from the IRB was also received to allow sharing of additional data relevant to producer perceptions from a previous project.

Subject matter experts were identified and are being interviewed to determine the critical control points for reducing the spread of animal diseases in the pork industry. Of particular interest are communication strengths and weaknesses at these control points.

Objective 2. Determine economic attractiveness of solutions that enhance biosecurity.

An expert survey has been designed (under the guidance of Iowa State University and Kansas State University collaborators) and will be distributed early in 2016 to swine, beef cattle, and dairy cattle experts. The main insights of this survey will be used in initial assessments of economic attractiveness in various biosecurity measures available for mitigating Tier 1 disease risks. Moreover, this survey will be used to subsequently shape producer surveys that will dive deeper into economic considerations directly from the producer's perspective.

Objective 3. Determine most effective communication strategies (message tactic and wording, channels, and sources). The groundwork for this objective was reported under Objective 1.

Objective 4. Integrate disease characteristics, human risk perception and socio-economic influences on behavior in a simulated "game" environment.

The Social Ecological Gaming and Simulation team received approval for the following three protocols from the University of Vermont's Institutional Review Board: (1) a protocol for experimental games which examine human behavioral approaches to reducing the impact

of livestock pest or disease incursions of socio-economic importance, (2) a protocol allowing for the use of Twitter and Amazon Mechanical Turks to recruit participants for online experimental games, and (3) a protocol covering interviews and expert input surveys.

Initial experimental games were designed and implemented in R. Forty-three of 100 expected participants played the game and completed a post-play survey as of March 14, 2016. Individuals interested in playing experimental games are being added to a participant database.

Two agent-based computer models have been developed to assess epidemiological characteristics of the hog production chain. The effect of producer specialization on disease percolation across the hog production chain network was simulated. A manuscript is in preparation.

Objective 5. Develop educational and outreach materials and methods that lead to measurable changes in attitude and behaviors at critical control points in cattle, swine and small ruminant production systems.

Under the guidance of Dr. McDonald, the educational outreach team (including collaborators at Washington State University and Montana State University) has assembled a Development Team and determined the subjects and learning objectives for the first six learning objects. Development was delayed by bureaucratic issues and the need to recruit a new digital designer for the project. The first learning object has reached the peer review phase. The design and storyboard for the second learning object is nearing completion, and will be handed over for digital design.

Investigators and educators involved in similar projects have been contacted to explore areas of synergism and holes to fill. It appears from these discussions that there is little developed for K-12 education related to biosecurity, so the initial focus on biosecurity education modules for 4-H clubs (grades 4-12) is a good place to start. However, designing and developing learning objects so that they can be used with 4th graders up through 12th graders is proving challenging.

What opportunities for training and professional development has the project provided?

Two graduate students and one senior undergraduate student have been included in planning and initiating the survey regarding critical control points for disease control. A doctoral graduate research assistant is currently enrolled in Agricultural Economics II (advanced treatment of topics and models in agricultural economics with emphasis on equilibrium analysis), Experimental Economics (introduction to experimental economics and major subject areas addressed by laboratory and field experiments), Machine Learning (subfield of artificial intelligence that is concerned with the design, analysis, implementation, and applications of programs that learn from experience), and Third-Year Paper (a formal research paper written as an introduction to the dissertation research process, which will utilize materials and methods developed in this grant research). An undergraduate has accessed online training for using project-related software--AnyLogic (for the development of agent- based models) and the gaming platform Unity. A doctoral graduate research assistant in the Food Systems program has enhanced his skills with computer modeling, complex network analysis, and web development.

How have the results been disseminated to communities of interest?

The first issue of the project newsletter was distributed early in 2016. The following presentations have been made by project collaborators or with reference to project products:

Smith, J. The complexity of saving your bacon: the policy and human behavioral challenges of protecting food animal health. Research Summaries Session, US Animal Health Association. October 26, 2015, Providence, RI.

Schulz, L.L. "Hog-Pork Market Update and the Economic Impact of PEDV." Presentation to North Japan Feed Association. Ames, IA. November 4, 2015.

Harry Snelson, Director of Communications - American Association of Swine Veterinarians, requested, cited and acknowledged results from Schulz and Tonsor (JAS) paper on economic impacts of Porcine Epidemic Diarrhea virus in the United States in a conference presentation in Parma, Italy.

Initial results from the case studies completed have been presented to the FDA, Joint Institute for Food Safety and Applied Nutrition (JIFSAN), and the attendees of the International Risk and Crisis Communication Conference (IRCCC). Details of the three presentations follow. The presentations to FDA and JIFSAN refer in detail to the ADB-CAP project to describe the application of risk and crisis communication to food and agriculture. The presentation to IRCCC focused entirely on the ADB-CAP case study.

Sellnow, T. L. Comprehending the role of message convergence for consistently effective message design in pre-crisis situations. Food and Drug Administration Meeting for the Risk Communication Advisory Committee, February 17, 2016, Silver Spring, MD.
Getchel, M. C., & Sellnow, T. L. Porcine Epidemic Diarrhea Virus (PEDV). IRCCC, March 5, 2016.

Sellnow, T. L. Crisis communication overview. JIFSAN 2016 Annual Symposium, April 4, 2016, Greenbelt, MD. Seminars explaining the value of data gathered using experimental games with examples specifically geared towards understanding the human behavioral approaches to reducing the impact of livestock pest or disease incursions of socio-economic importance were presented to members of the University of Vermont community and general public and members of the Experimental Program to Stimulate Competitive Research program, Research on Adaptation to Climate Change. Details of the two presentations follow.

Merrill, S. C. (2016) Experimental gaming research: the next step in data gathering and complex systems analysis. Research on Adaptation to Climate Change Retreat. Burlington, VT.

Merrill, S. C. (2016) Experimental Gaming Research, gathering data to understand Social-Ecological Systems. Plant and Soil Science Departmental Seminar. Burlington, VT.

What do you plan to do during the next reporting period to accomplish the goals?

The PD will attend the annual meeting of the National Institute of Animal Agriculture, which revolves around the theme of biosecurity in 2016, to maintain relationships with stakeholders interested in this aspect of the success of the food animal industries. The PD will also attend the USDA NIFA PI meeting in December in conjunction with the Conference for Research Workers in Animal Disease. Additional opportunities to present or meet to discuss potential collaborations will be acted on as appropriate.

Monthly team conference calls and face-to-face project team meetings twice a year will continue. A website to support project outreach is being developed. The project will be "branded" with the assistance of communication students at University of Central Florida. The plan of the risk communication team (University of Vermont, University of Central Florida, and North Dakota State University collaborators) for the next reporting period is to conduct research on the perceptions, beliefs, attitudes, and motivations of different groups of stakeholders (e.g., hog producers, processors, and haulers) to assess and plan, mitigate risks, and prepare to respond to Porcine Epidemic Diarrhea virus (PEDV). The first of two phases of this research will be completed focusing on PEDV risk management by exploring the area between what is possible and what is acceptable in terms of animal health protection from the perspective of industry experts. After completing the interviews of experts, data will be analyzed to characterize various influences on stakeholder behaviors at critical control points and where practices or protocols can prevent the introduction or spread of PEDV. This will accomplish two goals: 1) Facilitate understanding of expert perceptions for state-of-the-art in PEDV prevention and control practices that will be used in the producer interviews in the second research phase of the next reporting period. This expert information will guide our development of the next interview protocol aimed at understanding hog producer perceptions of PEDV and information preferences and needs. A typology for tailoring messages will be developed using the interview and focus group data, along with informational needs and survey results. 2) Increase understanding of the specific influences and interactions among people and locations in the hog industry. This will inform the development of an Agent Based computer simulation to assess the way diseases such as PEDV spread within the U.S. hog industry. Input from our advisory team and expert informants will be used to make a list of producers to contact for semi-structured in-person or telephone interviews. Results of phase one expert interview analysis will be summarized and presented in a research report for stakeholder groups and the gaming and education teams. Additionally, manuscripts and conference presentations will be developed and disseminated.

The plan of the economics team (Iowa State University and Kansas State University collaborators) is to analyze and report results from the expert survey. The producer survey and a decision tool spreadsheet will be under development or early deployment by the end of this reporting period. Topics related to this grant will be presented in a plenary session and council sessions at the National Institute for Animal Agriculture annual meeting in April 2016.

The Social Ecological Gaming and Simulation team (at the University of Vermont) intends to continue efforts on three fronts: 1) examining the role of information uncertainty on adoption rates of new animal health protocols, 2) examining the role of risk in compliance with existing animal health protocols, including starting to assess the effects of risk messaging to help increase compliance with existing protocols, and 3) examining current social network structures to detect critical nodes of potential disease percolation. Hypotheses are based on multiple theories of social behavior, primarily the theory of planned behavior and maximum expected utility. Multiple quantitative tools will be used to gather and test data, including games coded using the R programming language and games coded using the Unity platform. Agent-based modeling will be used to direct simulation and examine social network structures, such as transportation and production networks in the swine industry. An evaluation specialist will be overseeing the developmental progress of this objective as it is integrating information from the efforts of multiple objectives.

The education team (consultant McDonald, Washington State University, and Montana State University collaborators) plans to complete six learning objects for 4-H youth. All six will be piloted and revised as necessary. An evaluation specialist will be working with the team to oversee evaluation of the learning objects. At the project team meeting in May 2016, input will be gathered from collaborators on which demographic to target next for educational products, based on their research to date regarding target audiences, most effective messages, and motivations.

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	2.3	0	0.3	0	2.6
Professional	0.5	0.1	0.2	0	0.8
Technical	0.2	0	0	0	0.2
Administrative	0.9	0	0	0	0.9
Other	0	0	0	0	0
Computed Total	3.9	0.1	0.5	0	4.5

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
1			11.08 Computer Software and Media Applications.
1			01.09 Animal Sciences.
2			09.09 Public Relations, Advertising, and Applied Communication.
	1		11.08 Computer Software and Media Applications.
	1		45.06 Economics.

Target Audience

Animal agriculture stakeholders, particularly experts in the swine industry, have been made aware of the project through presentations at the US Animal Health Association annual meeting, participation in the fall project team meeting, and invitation to participate in project surveys and interviews. A project newsletter has been distributed to individuals in the food and agriculture sectors. Agency stakeholders with USDA, DHS, and FDA have been made aware through meetings. Contact has been maintained with the vulnerable population in the upper plains (USA) to be included in future surveys and interviews. Members of the University of Vermont community and general public attended seminars explaining the value of data gathered using experimental games with examples specifically geared towards understanding the human behavioral approaches to reducing the impact of livestock pest or disease incursions of socio-economic importance. University students have participated in experimental games.

Products

Type	Status	Year Published	NIFA Support Acknowledged
Journal Articles	Published	2015	NO

Citation

Schulz, L.L. and G.T. Tonsor. 2015. Assessment of the Economic Impacts of Porcine Epidemic Diarrhea Virus in the United States. Journal of Animal Science 93(11):5111-5118.

Other Products

Product Type

Survey Instruments

Description

An interview guide was created to guide semi-structured interviews on expert perceptions, beliefs, and attitudes of potential sources of Porcine Epidemic Diarrhea virus and practices for preventing and controlling the disease.

Product Type

Databases

Description

A participant database is being developed to track individuals interested in participating in experimental games.

Product Type

Other

Description

A Docear mind map was developed to visually organize literature on the swine industry and Porcine Epidemic Diarrhea virus.

Changes/Problems

Only one of the five original subawards was processed with the initial grant award. Three more were processed within about six months of initiating the project. The subaward initially proposed with University of Kentucky was established with University of Central Florida because the lead co-PI moved from Kentucky to Florida, where he will be joined by the North Dakota State University co-investigator later this year. As other pieces of the award were being processed in July, the University of Kentucky Research Foundation subaward was withheld so it could be awarded directly to the University of Central Florida. A separate subaward was established with North Dakota State University to cover the effort during the project period. The subawards with University of Central Florida and North Dakota State University were executed in February of 2016. Much of the proposed effort continued in spite of these delays but hiring of a graduate student for one objective was delayed.