

EX ANTE VS. EX POST BIOTERRORISM MITIGATION *

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Abstract

The economic implications of foreign animal and zoonotic diseases and their mitigation options has become a more pertinent issue as the fears of agricultural terrorism have grown. From an economic perspective, agricultural terrorism would cause damages by disrupting agricultural commodity and related markets either because of the events themselves or because of potentially expensive and intrusive mitigation actions. It has been documented that even unintentional outbreaks of diseases such as Foot and Mouth Disease (FMD) can cause substantial economic damages (Thompson et al., 2003). The total cost of a disease outbreak policy is composed of post outbreak economic losses brought by a disease outbreak weighted by outbreak probability plus the cost of any pre outbreak actions. This, in most cases, inherently implies a tradeoff between pre outbreak prevention and detection related costs and ex post losses from the outbreak management plus any associated recovery costs. In this paper we investigate these tradeoffs in an

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economic model examining tradeoffs between pre and post outbreak strategies as they are affected by outbreak characteristics such as outbreak probability, speed of disease spread, magnitude of disease introduced damages and cost of mitigation strategies.

Analysis of prevention and response strategies directed toward Foot and Mouth Disease (FMD) have been the topics of numerous studies (Bates et al. July 2003; Bates et al. September 2003; Garner and Lack, 1995; Schoenbaum and Disney, 2003; Berentsen et al., 1992). All of these studies mainly concentrate on post outbreak disease management including the optimal use of vaccination and slaughter. Less attention has been devoted to pre event surveillance and detection systems, which could allow for timely and more effective response measures but costs money whether or not an outbreak ever occurs. Although some attention has been raised towards surveillance systems (Bates et al. September 2003; Akhtar and White, 2003), no empirical investigation has been performed, to the best of our knowledge, on the merit of such policies relative to vaccination and slaughter.

Current US programs to detect and prevent FMD place a great deal of reliance on the recognition and reporting of clinical signs by producers, animal care takers, meat inspectors or veterinarians (Bates et al. September 2003). Reliance on such an approach raises two major problems. First, detection based on visual observation of clinical signs implies that the disease could have been present and possibly spreading before the realization of its presence. Second, clinical signs of FMD are indistinguishable from the signs of other diseases (Bates et al. February, 2003 a, b). Therefore, more reliable methods for detection of FMD may be appropriate. One of the possible surveillance and detection systems that could be used involves the use of periodic screenings of animals. Such screenings could detect FMD carriers before clinical signs appear. Earlier detection through periodic testing would allow for more timely implementation of response strategies such as vaccination, slaughter, disposal, cleaning and disinfection. Hence, by decreasing the time of unobstructed disease spread screening could reduce economic damages.

We examine the pre/post outbreak nature of an optimal response system considering various characteristics of a potential FMD outbreak, costs of program

implementation, severity of the disease outbreak, and relative effectiveness of the surveillance and response strategies. Specifically, we address under what circumstances is it beneficial to invest in the detection program incurring prevent costs but allowing the faster detection of disease outbreaks, versus relying on post outbreak response measures, which would be activated only if the outbreak occurs.

To do this we use a total cost minimization approach in the face of a stochastic disease outbreak. Total costs include pre outbreak expenses on surveillance and detection, along with a probabilistic outbreak under which society encounters the costs of response strategies, and economic damages from the outbreak. Surveillance and detection costs encompass pre outbreak fixed and variable costs of installing testing facilities and administering tests that are incurred regardless of outbreak occurrence. Response costs include post outbreak costs associated with vaccination and/or slaughter, which take place only if an outbreak occurs. Economic damages when an outbreak occurs include lost livestock value due to infection and earnings lost for infected animals and those destroyed in the process of outbreak management.

A two stage stochastic programming model with recourse is set up which reflects irreversibility of the decisions made in the initial stage. In first stage investments are made in cattle testing facilities and in conducting tests, including the option of doing nothing. In stage two there is a probability of disease outbreak and when this occurs then the outbreak is managed by initiating vaccination, destroying infected cattle and destroying those in the vicinity of an outbreak. In addition, surveillance mechanisms implemented in the first stage will facilitate faster detection of the disease and will allow faster response which will reduce the spread. However, if investment in detection mechanisms was not made in the first stage, then the disease will spread until the time of appearance and recognition of clinical signs. Under the scenario where there is no outbreak in the region cattle operations continue as usual. However, decisions made in the first stage will incur costs of investments and testing.

The results show that the optimal level of pre event detection investment depends on such factors as likelihood of disease introduction, disease spread rate, relative costs, ancillary benefits and effectiveness of mitigation strategies. Overall, the higher the

probability of disease introduction the more advantageous it is to invest in pre event detection mechanisms. However, for slow spreading disease the investment in surveillance and detection was found to be optimal only for very high probabilities of introduction. On the other hand for fast spreading disease cases pre outbreak investments were found to be optimal even for low probabilities of outbreak occurrence. For example, under a 0.2 probability of disease introduction expected losses amount to about 14% of cattle industry value. Investment in surveillance mechanisms allows this amount to be reduced to about 0.25%.

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