Introduction

Eradication of diseases from the U.S. livestock and poultry population has a long history, including declarations of freedom from contagious bovine pleuropneumonia in 1892, foot-and-mouth disease (FMD) in 1929, screwworm in 1959, and hog cholera in 1978, and we are now on the verge of eradicating brucellosis, tuberculosis, and pseudorabies (Dunlop and Williams). Many factors determine which diseases warrant eradication. Chief among them are concerns about human health, impact on livestock productivity, and restrictions imposed by importing countries on exports of U.S. livestock and livestock products due to the presence of disease (Wiser).

However, the eradication of so many diseases does not allow the United States to declare victory in the battle for livestock and poultry health. The competitiveness of U.S. livestock and poultry in domestic and international markets is constantly threatened by diseases in North America—both known and newly emerging and foreign and endemic—such as Bovine Spongiform Encephalopathy (BSE or Mad Cow Disease). Costs of just monitoring and surveillance programs for livestock diseases alone, estimated for the 2006 Animal Health Monitoring Systems budget at almost $150 million per year, are significant.

Cost/Benefit Analyses

Some earlier studies have done cost/benefit analyses for U.S. programs aimed at preventing or mitigating impacts of livestock diseases. Their conclusions point up the potential impacts of these diseases and the relatively limited costs of eliminating them. Discounted benefits to the United States of the screwworm program, which ran from 1958 to 1986, are estimated at $2.8 billion, compared with discounted eradication costs of $240 million (USDA/APHIS). For hog cholera, the 16-year eradication program (1961-1976) was estimated to generate $2.9 billion in benefits at a cost of $140 million (Wise). Estimates of the brucellosis eradication program (1985-2005) show an $18.3-billion gain in producer and consumer surplus as a result of the program (Dietrich, Amosson, and Crawford, 1987).

Other analyses reinforce the value of eradicating diseases, such as FMD, by estimating their impact should they reenter the U.S. livestock population. The potential losses from an FMD outbreak in California are estimated to range between $8.5 and $13.5 billion (Ekboir). A substantial share of those estimated losses, $6 billion, is attributed to an embargo on U.S. meat exports. Paarlberg, Lee, and Seitzinger (2002) estimate that an FMD outbreak similar to the one that occurred in the United Kingdom during 2001 could generate U.S. farm income losses of $14 billion. They estimate individual sector losses, measured from a no-disease baseline, as 34 percent for live swine, 24 percent for live lambs and sheep, 10 percent for lamb and sheep meat, 15 percent for forage, and 7 percent for soybean meal,

Paarlberg, Lee, and Seitzinger (2002) estimate that if only 7 percent of U.S. consumers react to an FMD outbreak by cutting meat consumption (i.e., in the mistaken belief that FMD causes human health problems), the national welfare losses from the outbreak would be more than double the amount of losses with no such response. However, in a later study, the same authors

(2003) demonstrate that—despite aggregate welfare losses—there are groups of both producers and consumers who can potentially make welfare gains during a disease outbreak. For example, producers who were able to sell cattle for beef benefited from higher prices.

Model-Based Research

The economic impacts of selected livestock and poultry diseases are determined by translating epidemiological impacts of the disease into the appropriate shifts in supply. The supply shifts are generated from estimates of disease prevalence found in the literature, as well as from results of the epidemiological disease-spread model, NAADSM (Harvey et al.). The results for each disease under alternative control simulations, such as ring slaughter within a radius of 1 km, are introduced into a U.S. agricultural sector model—along with information about trade impacts, regulatory costs, and potential consumer reactions—to determine the impacts on market prices, quantities, and the welfare of economic decisionmakers. The economic interests of those on and off the farm are affected somewhat differently by alternative control strategies.

A number of studies have used combined epidemiologic-economic frameworks. Ekboir (1999) uses an epidemiological model for an FMD outbreak in California dairy cattle as input into an input-output model for that State. McCauley et al. (1979) determined the potential impacts of a hypothetical FMD outbreak in the United States and the costs of alternative control strategies. Berentsen, Dijkhuizen, and Oskam (1992) and Dijkhuizen, Renkema, and Stelwagen (1991) examine a potential Dutch outbreak of FMD. Rendleman and Spinelli (1994) use a national simulation model to analyze the economic impacts of an outbreak of African swine fever in the United States. Petry, Paarlberg, and Lee (1999) estimate the adverse impacts of porcine respiratory and reproductive syndrome (PRRS) on U.S. swine trade with Mexico. Zhao, Wahl, and Marsh (2006) present an analysis of an FMD outbreak on the U.S. beef sector that integrates an epidemiological model with an annual dynamic model of the beef and beef cattle sectors. Seitzinger, Paarlberg, and Lee (2006) use a similar framework in analyzing the effects of a scrapie outbreak.

This previous research quantifies the economic impacts of selected livestock and poultry diseases that pose a threat to the competitiveness of U.S. livestock and poultry and the products derived from them. The studies focus on the economic effects of consumer and international trade responses to the presence of livestock diseases and alternative disease control strategies. However, the framework in our study extends previous work in two ways: it includes the major agricultural products along vertical market chains from livestock products to animal agriculture and crops, and it has the capacity to follow the effects over 20 quarters (see also Paarlberg, Seitzinger, and Lee, 2007).

The next section presents a conceptual model that integrates components from economic and disease-spread modeling frameworks. FMD is chosen to illustrate disease impacts because it is among the most common foreign animal diseases and has an extensive body of research from which to extract disease-spread parameters needed for the framework.