Economic Perspectives on Management of Livestock-Disease Emergencies

by Richard P. Horwitz, February 23, 2017

In dealing with outbreaks of highly contagious livestock disease (e.g., HPAI, END, FMD, PRRS, PED), incident managers have long sought reliable estimates of the costs and benefits of the options they face. Planning would sure be easier. Conditions on-the-ground and competing priorities – bio-medical, budgetary, logistical, political, ethical – may rule in the end, but leaders still prefer strategies with a record of gains that are greater than costs. They at least want to know how much "bang for the buck" one tactic is apt to deliver when compared to another. Or once the dust settles, they want a tally of the human and environmental losses that an incident entailed or that it would entail under other circumstances. The following is intended to introduce prospects for realizing such hopes, according to reviews of the literature in economics.

Of course, that literature as a whole is vast. Much of it (e.g., basic theories and methods) could apply or be extended to shed light on just about any human or natural event. The focus here, though, is on the relatively few publications (albeit still numbering in the hundreds) that explicitly address impacts and options for dealing with things like outbreaks of livestock disease. In economics such events are usually classified as "biological hazards," meaning agents (pathogens, invasive species, toxins) that can harm other living things.

Reviews indicate that studies of the economics of preventing, controlling, responding or adapting to biohazards tend to focus on a more specific target within one of following areas:

- Drivers – incentives for patterns of action with consequences that include an increase in the frequency or severity of biohazard incidents
    - Globalization – faster, more frequent, and more distant movement of people and goods
        - Expanded transportation infrastructure
        - Multilateral trade agreements
        - Growth of market share for multinational production, processing, marketing, and transport companies
        - Terrorists and refugees traveling from sites of conflict
    - Agricultural intensification – growth of farming systems that incorporate large-scale, high-density production of more genetically uniform stock and more frequent, longer-distance transport of inputs and outputs
        - The Green and Livestock "Revolutions"
        - Aquaculture
        - Genetic engineering
        - Increased supply and demand for a "globally standard diet," including larger quantities of less diverse livestock products, fruits, vegetables, and grains
    - Land use – expansion of grounds for human occupation, extractive industries, or cultivation and loss of contiguous wildlife habitats
        - Urbanization
        - Filling of wetlands
        - Deforestation
        - Population growth
    - Accelerated global climate change
        - Generation and release of greenhouse gases
        - Reduction or displacement of habitats for host and pathogens
        - Loss of climatic restraints on the range and life cycle of pathogens

- Impacts – the consequences of a biological emergency that are monetary or that can be measured as such
    - Direct cost of emergency prevention and/or response and recovery
    - Lost production, employment, income, trade, market share, currency and credit reserves
    - Food security
    - Tourism
    - Public health and peace of mind
- Management – costs and benefits of options for emergency planners and responders
    - Strategy
        - Prevention, eradication, control, containment, restoration or adaptation
        - Priorities among hazards to control or hosts to protect
        - Procedures for mixing or adjusting strategies, given sundry constraints (e.g., resource availability, cost-sharing among stakeholders, levels of uncertainty)
    - Field tactics – methods of pursuing a strategy
        - Setting spatial parameters (e.g., optimal quarantine, control, or eradication zones, regionalization of trade barriers)
        - Surveillance and monitoring (e.g., optimal sample size and frequency, location, oversight, human health and safety protections)
        - Vulnerability assessments and hazard mitigation
        - Depopulation and carcass disposal
        - Vaccination and pesticide selection and application
        - Indemnification and restoration services
    - Policy instruments – ways to develop social support for incident management
        - Education and public communication
        - Regulation (command/control)
        - Insurance
        - Indemnification or tariff
        - Assessments (e.g., public/private, producers/consumers)

Whatever the specific subject, reviewers in economics find that such published studies tend to share the following qualities:

- Publication – Coverage is uneven, thin overall as a subspecialty, albeit with a slowly rising page count in mainstream economics journals and more in interdisciplinary serials.
- Authorship – Authors are often not credentialed in economics per se. Their area of expertise is usually modeling, with some cross-training in the biological and health sciences that are the source of most data and less in economics itself.
- Hazard – Biohazards of interest in economic research are diverse and greatly vary by location, but a large and growing share are invasive species (e.g., zebra mussel, Argentine ant) with environmental impacts.
- Vulnerability – The largest share of publications (about 40%) focus on threats to animals, with the remainder about equally divided between plants and the environment (about 25% each) and with a smaller share (about 10%) on human health.
- Location – The vast majority of publications originate from and address “the wealthy West,” with the largest share (about 35%) focusing on the U.S., followed by Australia, the United Kingdom, and the Netherlands (about 10% each). Asia and Africa are understudied, with a handful of countries (e.g., South Africa and the U.S.) dominating research on whole continents.

- Data – Data selection privileges the most readily quantifiable, especially monetary variables, with a shortage of well-vetted, comparable data on trade, employment, and private-sector finances, especially at the individual farm-, processor-, or distributor-level.
- Methods – Among the "methodological shortcomings" economists commonly find in this literature (e.g. in cautioning those eager to apply it or in prioritizing future research):
    - Focuses on one or two hazards at a time, even though multiple hazards (e.g., occupational safety and animal welfare as well as disease) normally occur in an actual incident and many responses (e.g., enhanced biosecurity or depopulation) affect several hazards at once.
    - Presumes that the main alternative to the tactic or strategy under investigation (e.g., pathogen eradication) is, in effect, doing nothing, accepting the bio-hazard, thereby, for example, bloating the potential benefit to equal 100% of incident cost (vs. a proportionate share, given multiple hazards and effects of remediations.)
    - Compares a narrow set of reactive tactics (e.g., depopulation, vaccination) to the neglect of a larger set that are apt to be competing for strategic attention (e.g., adaptation, prevention, proactive resource allocation) in managing such incidents.
    - Underemphasizes diversity among stakeholders' roles, vulnerabilities, and resources and thereby the potential for varied impacts and conflicting interests.
    - Stresses microbiological sources of risk, commercial agriculture and use values to the neglect of other social or ecological values (e.g., trade, tourism, employment, business continuity, biodiversity) that may be harder to quantify but that may also be important in determining risks that the incident poses for society and the environment.
    - Provides inadequate analysis of confidence levels that findings warrant (e.g., estimates of standard error in measurements and sensitivity and uncertainty analysis in model runs) to meet current quality-assurance standards.
    - Lacks well-vetted and standardized protocols and parameters for risk assessment, making findings difficult to compare or cumulate.

Despite these limitations, one of the great, consensus contributions of the field has been mapping broad social and environmental terrains. The act of measurement alone requires precision in identifying the range of facts that should be considered relevant and in assigning them a calculable, comparable value.

> *The economic foundation of the studies is not as strong as it could be . . . The value of modelling is the actual process of working through the problems and issues rather than the identification of a final solution. Modelling helps in conceptualising and thinking through complex problems analytically.*
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> -- Heikkilä (2011) [1]

Cost-benefit analysis, for example, requires being particularly explicit about the range of investments and impacts that are counted. The net financial pay-off – say, for investments to reduce risks of deadly infection by some increment – can only be figured after deciding what increments count.

"Benefits" could be limited to the market value of each animal saved or extended to include rate-of-gain and immunological rewards for generations of offspring, protection from future outbreaks

[1] Jaakko Heikkilä, "Economics of Biosecurity Across Levels of Decision-Making: A Review," *Agronomy for Sustainable Development* 31:1 (January, 2011), pp. 123, 125.

or vaccination, the short- or long-term prosperity of farmers and the communities where they live, or of distant processing and marketing operations, insurers, haulers, retailers, consumers and tourists. Economists can, for example, put a dollar value on the mere thought that familiar foods remain available or that pastures exist. Likewise, the "cost" of a control tactic – say, spraying tractor tires with bleach – could be limited to the price of a gallon of Clorox or extended to include the value of time diverted from other tasks, wages or potential injuries to workers or to phytoplankton and the wildlife that feed on them and descendants downstream.

To the question of what counts as "cost" or "benefit," add the specific way each is calculated, and the result is a very large number of arguable points, and they are argued vigorously in print. In fact, much of the literature begins with the discrediting of back-of-the-envelope figures that appeal to common sense. Whatever glitters in light of lay or first-try analysis is apt to look dimwitted to modern, professional economists. Whatever their differences, they can agree that cost-effectiveness is tough to determine. Its calculation best encompasses many, varied observations or model-generated estimates and sophisticated understanding of their limits and connections.

Key considerations that economists counsel in planning to reduce drivers or impacts and to optimize response strategies and tactics include:

- Cost-benefit ratio
    - Given existing estimates and past experience, what is the most effective direct investment in risk management, incident prevention, readiness, and response?
    - How are indirect and direct costs and benefits (e.g., short- and long-term effects on the risk from other biohazards, effects on market-share or integrity of supply chains, consumer prices, etc.) likely to compare for each potential remediation?
- Affordability and ease of implementation
    - How much investment is apt to be required, start-to-finish?
    - Who can afford to pay the cost, and who can collect it?
    - Are logistics adequate for timely access to resources?
- Allocation of costs and benefits among stakeholders
    - Who pays and who gains?
    - How do differences in investments and impacts affect stakeholders with competing interests and condition their support?
- Uncertainty
    - How complete and reliable is information on the hazard and the incident?
    - How is that information understood and shared?
    - How much are actual costs and benefits apt to differ from estimates?

These are the sorts of questions that economists skillfully ask and that could greatly contribute to incident management. Regrettably, the answers that have been published to date significantly hedge their bets. Their answers are not very uniform, stable, portable, or applicable in any simple, direct way. For example, economists do not much agree on the cost-benefit ratios of specific response tactics or strategies or the actual cost of prior outbreaks.

The existing literature is more useful for crediting claims about relative costs and benefits – which options seem to have proven and could prove more or less cost-effective under particular circumstances – than for yielding straightforward, reliable and portable estimates, a bottom-line figure with a confidence level. The field of economics can contribute wise questions to ask, with some solid directions on what to consider, but the answers themselves are more likely to emerge in practice.