BIOSECURITY IN AGRICULTURE: Perspectives from Social Science

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July 19, 2017

Questions about the effectiveness of biosecurity: contexts and perspectives

1) Can farmers, consumers, and emergency managers count on biosecurity to adequately reduce the risks of outbreaks of highly contagious or zoonotic livestock diseases (TADs)?

   Short answer: Maybe, but maybe not. It depends on the context.

   Undoubtedly one of the oldest forms of biosecurity – a quarantine, cordoning off a single site or a few clusters of them – will remain essential in first response. The benefits in a focal outbreak are well proven.

   Undoubtedly, too, biosecurity in the form of consistent, basic sanitation (e.g., clean water, feed bunks and bedding, clean hands, coveralls and boots, akin "universal precautions") can help reduce risks of infection, at least for individuals in the short run. What's less clear is the effect of enhanced, everyday biosecurity as a way to reduce disease in modern livestock facilities, over the long run.

2) Are there other perspectives on risk reduction that the current focus on biosecurity may obscure?

   Short answer: Yes, there are, particularly in the social sciences.

   These perspectives emphasize social, cultural and institutional dimensions of modern agriculture. (Hence, they can be called "perspectives from social science," even though the publications or people using them may also be associated with interdisciplinary, natural or medical science.)

   Social science perspectives encourage a shift in focus in emergency management from the biology of emerging diseases (e.g., via surveillance, sanitation, and vaccination) to drivers of animal health that are socially constructed and that public policy could change.

   Such perspectives are most likely to be featured in criticism of state-of-the-art livestock production practices for harboring risks that biosecurity protocols may not reduce or may even amplify.

Background

No matter what the disciplinary home – in the natural as well as human sciences – research specifically on biosecurity has been sparse. The word "biosecurity" was first widely publicized by commodity-groups, agricultural science departments, and USDA Extension about fifteen years ago, after FMD broke in the U.K. and "white powder" reached halls of power.

At that time, as research on emerging diseases and bioterrorism intensified, relevant data sets were incomplete at best. They were mainly extrapolated from records of inconsistent quality and relevance that happened to be available from an outbreak or two in the past. For good reasons, they almost never came from controlled experiments under anything like real-world circumstances, much less systematic, hypothesis-guided observations in the field.

As a result, the empirical foundation for biosecurity advisories in agriculture remains narrow and shallow. (See also Biosecurity, Infection Control and Continuity of Diary Operations in FMD Response and Farm Biosecurity: A Reassessment of Feasible Benefits in an Outbreak.)

Despite nearly universal enthusiasm for ever-greater biosecurity, there is still plenty of room for disagreement about its rewards in everyday practice. For example, people who work on farms flout biosecurity advisories that they well know, even in the face of daily reminders. Witness, for example, how often livestock handlers step over or around a boot bath at the barn door.

There is also very little scientific evidence for the effectiveness of any specific mix of measures or alleged "level" of biosecurity. Among the questions begging for investigation:

- Do benefits accrue in proportion to the effort or only once a threshold – a minimal set of particular precautions – is reached? What would that minimum be for various species or stages of life?
- Is there a maximum, a point of diminishing returns beyond which disease-spread risks remain or worsen with greater effort?
- Is there a relationship between these two thresholds, between the least and the most effective effort, particularly in normal husbandry?
- Or does biosecurity, as guidance often implies, have limitless benefits that just have not yet been realized? Could farms be as "secure" as BSL-3 or BSL-4 laboratories?

There is no consensus, research-based answer, though there are some inspiring precedents of late in the swine and poultry industry. At the moment, the answer chiefly depends on who you ask.

"Biosecurity" in social science

Published opinion in social science is even more recent and thin than in applied, natural or medical sciences. The word "biosecurity" is barely detectable before 1980. References rose explicitly in response to experience with HIV, FMD and SARS and then evidence of bioterrorism (along with increased funding for scholarship on these subjects) after 2001. Lead authors mainly hail from the English-speaking world, the United States, the United Kingdom (especially England and Wales), and New Zealand.

To this day, depending on the subfield and the author's point of reference, the word "biosecurity" (or "biosafety") can be applied to very different things. For example, sometimes the term refers only to government restrictions on the import of "invasive" plants or insects. At others, it refers to laboratory or pharmaceutical factory protocols to prevent pathogens from escaping. In yet others (typically in the U.S.), it refers to the design of facilities and farm practices to exclude disease from (or in an outbreak, to confine it within) a feedlot, swine or poultry facility.

These very different uses of the word have in common a territorial sense of "security." The aim is to maintain a literal barrier (a.k.a. "line of separation," the ecological equivalent of apartheid) between environments with pathogens and environments with susceptible hosts. Disease risk should be perfectly corralled, remaining potentially high on one side of the barrier (where pathogens are contained) and negligible on the other (where pathogens are excluded).

Chiefly at issue, though, whatever the domain of reference, is the possibility and desirability of keeping pathogens and hosts apart. So, skeptics ask, when or in what ways is biosecurity (construed as separation) truly apt to reduce risks of highly contagious or zoonotic disease?

Lessons of biosecurity success and failure

Thin and uneven as the evidentiary base may be, most publications still acknowledge that biosecurity has a record of both promise and failure in practice. Biosecurity measures have been implicated in victories as well as defeats in preventing catastrophic disease.

Note, for example, that the Midwest HPAI outbreak of 2015, the most deadly in U.S. history, entailed about triple the number of casualties as the second worst, back in 1983, well before biosecurity was improved. However, enhanced biosecurity was officially credited with helping eradicate another AI strain in Indiana just one year later.

Applied agricultural sciences generally conclude that such a mixed record indicates, not intrinsic limits in the strategy, but a need to pursue it more vigorously. Where social scientists tend to differ, then, is in their take on that mixed record.

They are less willing to concede that biosecurity has been proven effective whenever catastrophe is averted: Protocols were embraced and disease was controlled . . . case closed. But if similar protocols are embraced and disease rages, the biosecurity faithful argue (and usually can find anecdotal evidence) that protocols were not properly implemented. For skeptics, this is hardly an even-handed way to interpret the facts.

Besides, a risk-remediation strategy that is so vulnerable to human error can hardly be considered resilient or sustainable. Geographer Stephen Hinchliffe dubbed this paradox "the insecurity of biosecurity." Livestock, the people who work with them, consumers, and producers, he warns, register gains as never before, but they/we are thereby also only "a handclap away" from catastrophe. So, in the social, cultural, and environmental sciences confidence in the benefits of biosecurity are consistently lower than in other fields, but it still ranges substantially.

Confidence tends to be greater in relatively "hard" or "tough-minded" (experiment- or measurement-minded, more politically conservative) fields like economics than in relatively "soft" or "empathic" (participant- and context-minded, more politically progressive) social, environmental, and cultural sciences.

For example, most discussions of the economics of biosecurity assert that the costs of preventive measures such as enhanced surveillance and sanitation are a bargain (at least when presumed to be "done right") compared to the cost of dealing with an outbreak. Benefits, modelers normally assume, should be roughly proportional to biosecurity "compliance," and failure of controls "must" mean that compliance was flawed. But even then, such assertions are more tentative in modern behavioral economics than in classical, model-centered economics.

Since 2000, more culturally, politically and environmentally oriented, qualitative social scientists have grown increasingly skeptical.

Whether or not by design, their doubts appeal not only to "the data," flawed as they are, but also to prejudice, setting modernity against tradition, nature against culture, or "factory farms" against small-is-beautiful locavores. (An analog for the biosecurity faithful would be first-world sanitation versus third-world squalor.)

Well before considering any evidence, self-styled "progressives" could well be ready to blame disease outbreaks on malpractice among the tiny number of corporate behemoths that, in fact, control most of the inputs and outputs of farms in the U.S. If agribusiness and its allies advocate more biosecurity, underdogs and their advocates are ready to howl.

But skepticism toward biosecurity is much more complex and sophisticated in the literature itself.

"Neoliberalism" in perspectives on biosecurity

Recent social scientific evaluations of "biosecurity" are rooted in far-ranging, intricate debates about "neoliberalism," with its emphasis on the redemptive power of unfettered markets and small government.

This ideology (or "paradigm" or "discourse") has roots in laissez-faire policies of the Nineteenth Century, that were revived in the 1930s in Continental schools of economics. It gained traction in public-policy circles of the U.S. as well as Western European in the 1980s as an alternative to waning post-war liberalism (with its emphasis on state protection of individual rights) at nearly the same moment as the focus on emerging diseases, bioterrorism, and biosecurity.

Neoliberalism is now arguably the dominant discourse of the West, with policy discussions tethered to its tenets. For example, U.S. "conservatives" tend to embrace nearly all of them while "progressives" emphasize those that seem more compatible with unreconstructed or leftist alternatives to post-war liberalism.

Key tenets of neoliberalism include:

- Promoting free markets and especially free trade as a way to "lift all boats" (also a tenet of post-war liberalism).
- Reducing the size of government and insofar as possible privatizing its functions (e.g., empowering institutions like the World Bank or the IMF to "incentivize" austerity and compliance with "harmonized" protocols as conditions for sharing resources with "developing" regions).
- Shifting responsibility for regulations from command-and-control, public-sector agencies to market-oriented "partnerships" of government and industry (e.g., as in managing trade to accommodate the effects of market "freedom" on participants with unequal resources).
- Using public policy to subject otherwise "political" disputes (open struggles for advantage) to technical, administrative standards or procedures and "market forces." Policy makers encourage or require rivals to defer to centrally crafted, expert- and market-justified, "nonaligned" rules of operation (e.g., OIE codes on surveillance, management, and prevention of livestock disease or EU and US efforts to "advance" TAD-response protocols in developing nations).

"Biosecurity" can be implicated in nearly all of these core tenets of neoliberalism. So, often at issue in social science (and often escaping other scholars' attention) is the way an analysis of biosecurity coheres with what are understood to be the best and worst features of neoliberalism more generally.

In other words, perspectives on biosecurity in social science tend to be structured by conventional critiques of neoliberalism, much as perspectives in veterinary medicine are structured by conventional wisdom in virology, immunology and epidemiology.

Social-science perspectives in practice

Social scientists deploy their perspectives in anticipating how biosecurity plays out in the real world. They ask, in effect, what would make a herd or its handlers more or less vulnerable to disease, given neoliberal drivers?

Natural or medical scientists, well-represented in livestock-policy circles, are apt to answer that question by deploying a perspective that presumes a different sort of foundation: "the" biology of

pathogen-host interactions, as extrapolated from laboratory experiments, where “everything else is held constant.” Social scientists are more apt to assume that “everything else” is crucial.

They look for ways that institutions and traditions make disease exposure, infection, and transmission more likely. Enhanced biosecurity from such a point of view immediately seems more like a response to rising risk than an intervention in whatever drives it.

Their perspectives highlight alterable arrangements – opportunities that people may seize or miss – more than biological destiny. Potential drivers include the distribution of resources (genetics, finance, regulations, market influences), the conditions in facilities (pastures, barns, feedlots) where livestock live, and the management practices of the people who affect them, all potentially predictable in a neoliberal context.

This is not to say that the goals of modern farmers (beyond a good life for participants, their families, and communities) are much different now than they ever were:

- The production of nutritious, affordable food and fiber,
- Return on capital and labor invested,
- A dependable supply of inputs (e.g., finance, breeding stock, feed/fertilizer, water, fuel),
- Efficient use of those inputs (e.g., feed conversion rates, weanings per year, time to market).
- Strong demand and ready access to markets for their products.

Critics suspect that the recent spike in risks of disease outbreaks may be driven, not by old ends, but by newly reigning means to achieve them:

- Contracting with companies that provide exclusive access to capital, supplies, national and international markets, and favor with government “partners” in exchange for exacting operations and performance requirements.
- Reliance on standard, uniformly “high-performing” genetics in seed stock that are naive to select infectious agents.
- Segregating livestock by age and shipping them, long-distance from site to site at each phase of production/stage of life.
- Engineering housing to maintain temperature, feed supply, light, air-exchange, and humidity for finely tuned, maximum production.
- Housing the largest possible number and density of livestock in those facilities for the shortest possible time to market, with minimal fallow time between refills, “all-in, all-out.”

The insecurity of biosecurity

Life scientists and social scientists tend to agree that these practices normally produce food and fiber remarkably well but that they also tend to increase the risk of exposure, infection, and transmission of disease. Facilities are, in effect, both more successful in meeting agricultural goals most of the time and better positioned for total collapse at any given moment. For example, raising the density of animals and the number of shipments to and from each site increases the likelihood of pathogen exposure and transmission. Raising the sheer number of animals at each site increases the number of casualties that will be inevitable if biosecurity fails.

The biosecurity of a facility that is densely populated with uniformly, immunologically naïve animals at a single stage of life may actually increase the likelihood that a speck of low-path virus will evolve to a high-path virus in-house. (These facilities massively replicate the conditions that laboratories simulate in vitro to produce stocks of HPAI for study.)

As Hinchliffe, among others, explains:

> "*This shift to high and accelerated throughput [i.e., productivity] has resulted from a variety of biological, technological and social changes. . . . The result is cheap protein but also a life that seems constantly on the edge of 'safe'. . . a condition related less to the passage of disease from outside, but more to its amplification within. Indeed, the notion of biosecurity tends to obscure rather than highlight the compromised ecologies of resilience that may characterize integrated and intense poultry systems. . . . The more we enclose those lives, the more we may, inadvertently, ensure that their circulations have even greater potential to generate new threats. . . . So, instead of asking whether or not we have full integration and compliance with a single model of biosecurity (integration and separation), we need to shift the debate to ecologies of production, resilience, and circulation."*[*]

In the view of such social scientists, tighter biosecurity is less a source of strength than a sign of weakness in livestock production systems. For protecting animal health and the food supply, it is in effect an instrument of deferred maintenance, like using duct tape on a crumbling wall or a leak in a ship's hull. The best it can do is buy some time; the worst it can do is pass as a solution. In the poultry industry, the point of diminishing returns may well have already been surpassed, and the swine industry may not be far behind. Cattle, especially dairy, may be lagging, but that could be an opening to implement a different perspective.

Lessons for emergency management

Social-science perspectives suggest reasons for change mainly in the prevention and recovery rather than response phases of emergency management. Even if social science perspectives were more broadly shared in agribusiness, public health, and veterinary medicine, much of the key strategies of emergency management would remain unchanged.

Even in peace time, for example, surveillance, communications, and rapid coordination of response efforts must remain a priority. Plainly, too, during an outbreak separation in the form of quarantines could help.

But insofar as possible – certainly before and after a crisis – there may well be benefits in directing management measures to better encourage change in livestock production systems, to promote alternatives to biosecurity that are less dependent on an unsustainable or even self-destructive separation between livestock and a diverse, dynamic, wider world.

[*] Paradox in the relationship between biosecurity and emerging disease (as well as containment and chaos more generally) is nearing conventional wisdom in social, cultural, and environmental studies of intensified, integrated production systems. Intellectual debts to Michel Foucault, best known as a French philosophical maverick in the middle of the last century, are glaring, but the point of view is now quite mainstream. Steve Hinchliffe is Professor of Human Geography at University of Exeter, a member of the Social Science Research Committee of the Food Standards Agency and the Science Advisory Council Social Science Expert Group (SSEG) of the Department for Environment, Food and Rural Affairs (DEFRA), as well as a Fellow of the Academy of Social Sciences in the U.K. "The Insecurity of Biosecurity: Remaking Emerging Infectious Diseases," in *Biosecurity: The Socio-Politics of Invasive Species and Infectious Diseases*, Andrew Dobson, Kezia Barker, and Sarah L. Taylor, eds. (New York: Routledge, 2013), pp. 206-210.