

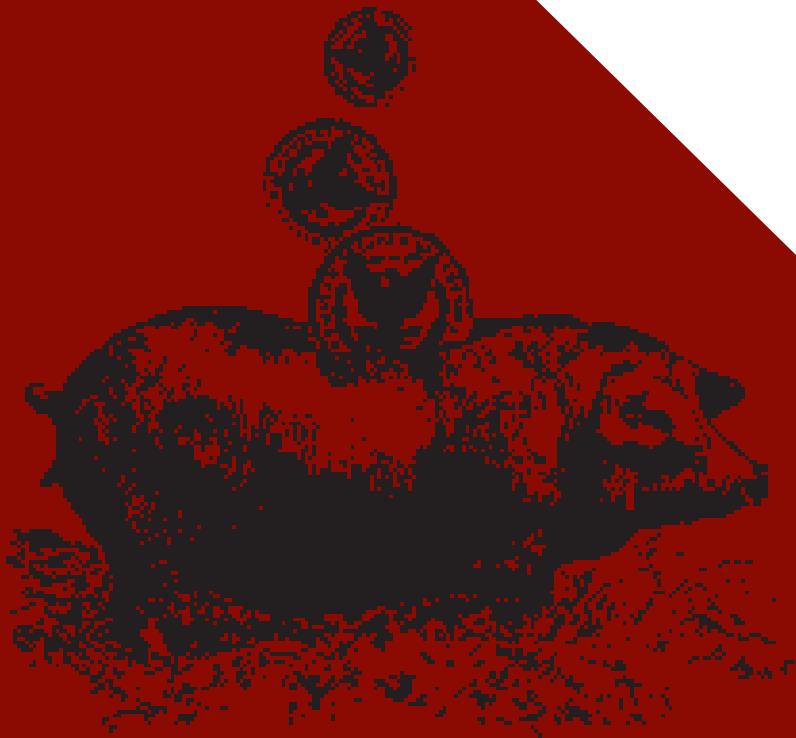
A Project of the



JOHNS HOPKINS
CENTER *for* A LIVABLE FUTURE

Industrial Food Animal Production in America:

Examining the Impact of the
Pew Commission's Priority
Recommendations



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Introduction to CLF Analysis and Assessment

Each year, approximately 9.8 billion food animals are raised and slaughtered in the United States primarily for domestic consumption but also for the export market. Most Americans have no idea how and where those animals are raised. Beginning in the 1950s, the food animal production system began to change from a diversified, extensive system with more than one species being raised on a farm, to a specialized, intensive system with large numbers of animals of the same species raised in confined spaces that resemble low-rise industrial buildings more than traditional barns.

This change, which has led to some economic efficiency, has also caused serious problems in the areas of public health, the environment, and animal welfare. In addition, this more intensive system has had unintended negative consequences for rural communities, in many instances hindering economic growth.

The Pew Charitable Trusts was established in 1947 to inform public discussion on a variety of issues, especially in the areas of public health and the environment. According to its website, “Pew applies a rigorous, analytical approach to improve public policy, inform the public and stimulate civic life. ... Pew is a global research and public policy organization, still operated as an independent, non-partisan, non-governmental organization dedicated to serving the public”¹.

In the early part of the last decade, Dr. Joshua Reichert at The Pew Charitable Trusts contacted Dr. Robert S. Lawrence, director of the Johns Hopkins Center for a Livable Future, to discuss developing a project to study problems associated with industrial food animal production in the areas of public health, the environment, animal welfare, and rural communities.

The Pew Commission on Industrial Farm Animal Production (“the Commission”) was established in 2005 by a grant from The Pew Charitable

Trusts to the Johns Hopkins Bloomberg School of Public Health. The charge to the Commission was to “...to investigate the problems associated with IFAP operations and to make recommendations to solve them.”

Naming the Commission was the first task. The funder and sponsor sought a name that would accurately reflect the historic scope of the Commission’s charge. During the 1940s and 1950s the large scale, confinement advocates called that style of production “factory farming.” Factories had supplied the armaments and materials needed to win World War II, were providing an abundance of consumer goods following the war, and were the source of solid, middle-class jobs. When the term “factory” became more associated with the polluting industries in the 1970s, large scale, animal confinement advocates adopted the term “industrial” animal production as a more accurate reflection of the scale and integration of the predominant food animal production system. More recently, the industry has used the term “modern” animal production in an effort to refer to large confinement operations in a more positive manner.

After much deliberation, the Commission name was established as the Pew Commission on Industrial Farm Animal Production to specify the type of food animal production system it investigated, including its consolidation, integration, scope, and size.

The Commission comprised 14 experts in the areas of public health, medicine, ethics, animal health, state and federal policy, animal husbandry, production animal agriculture, nutrition, rural sociology, religion, and the meat industry (a list of Commissioners is provided in the Appendix). The Commission met over a period of two and a half years. During that time, it conducted 11 meetings, two of which were public, in all regions of the United States. Meetings were held with a wide range of stakeholders, including representatives of the food animal species promotion groups, farmers, traditional farm organizations, consumer advocates, animal welfare advocates, federal regulators,

environmental activists, agricultural producers, and a wide range of academics.

The Commission visited industrial swine and sustainable swine operations in Iowa and North Carolina, industrial battery cage egg production and cage-free egg production in Colorado, a large dairy concentrated animal feed operation in California, a large cattle feedlot in Colorado, and an industrial broiler production CAFO in Arkansas. Eight technical reports were requested by the Commission from teams of authors at a variety of academic institutions, with report topics including antibiotic resistance, environmental impacts, human health issues, animal health concerns, animal welfare considerations, and the impacts on rural communities. In addition, the Commission partnered with the National Conference of State Legislatures to develop a state-by-state review of existing state regulations and resources available to implement those regulations.

The Commissioners deliberated for more than 250 hours, during in-person meetings as well as during conference calls, reviewing information and discussing possible recommendations. Many more hours were spent between meetings reviewing information provided by Commission staff, including at least 170 peer-reviewed academic papers and thousands of pages of information provided by stakeholders.

Twenty-four broad recommendations were developed in the four main areas of study (public health, the environment, animal welfare, and rural communities), with one general recommendation that did not fit easily into the four categories. Twelve of those 24 recommendations fell in the public health arena, with five of those dealing with antimicrobial use. The remaining 12 recommendations included five focused on the environment, five dealing with animal welfare issues, and two on rural communities. The one recommendation that did not fit into any of the four categories, but that the Commissioners considered important, was improving the public funding of animal agriculture research

to compensate for the research funded by the industry to promote its business model.

The Commission found “significant influence by the industry at every turn: in academic research, agricultural policy development, and government regulation and enforcement.” More broadly, the Commission found that “the present system of producing food animals in the United States is not sustainable and presents an unacceptable level of risk to public health and damage to the environment, as well as unnecessary harm to the animals we raise for food” ².

The Commission released its much anticipated report on April 28, 2008, immediately gaining the attention of state and federal policymakers, environment and public health advocates, academics, as well as animal agriculture producers and companies. There are several reasons for that.

The Pew Commission report was the first time the public health, environment, animal welfare, and rural community problems caused by large scale, intensive animal confinement operations were looked at as systemic problems and not as separate consequences of food animal production. It represented a thorough compilation of the research existing at the time and compiled that information in an accessible format. The diverse backgrounds of the Commission members, their credibility and respect in the areas of interest, and the thorough investigation of the problems strengthened the final report.

Commissioners believed that with the involvement of The Pew Charitable Trusts and the Johns Hopkins Bloomberg School of Public Health, two excellent “brands” were supporting their effort. Both The Pew Charitable Trusts and Johns Hopkins are well respected among policymakers at all levels. Pew’s commitment to Commission autonomy and Hopkins’ commitment to providing technical support and issue expertise were essential.

did not start with the Pew Commission report. However, it did provide new, evidence-based information organized in a compelling narrative. Following the release of the report, Senator Edward Kennedy (D–MA) initiated efforts to legislate a ban on antibiotics important in human medicine for use in food animal production.

Even though unsuccessful, that effort led The Pew Charitable Trusts to establish two issue campaigns to promote the adoption of some of the Commission's work; the Human Health and Industrial Farming Campaign and Reforming Industrial Animal Agriculture. Additionally, the Natural Resource Defense Council, Union of Concerned Scientists, and the Keep Antibiotics Working coalition were aided in their efforts by the report.

The work of the Commission helped generate new media attention to the issue, including hundreds of stories using the report as an information source, including *TIME* magazine, *Prevention* magazine, *The New York Times*, and *The Washington Post*. The report remains a landmark work and is still consulted by media, academics, and policymakers when considering food animal production.

The fifth anniversary of the release of the Commission report presented a logical opportunity to assess the work done to implement the original recommendations and to determine the continued relevance of them. The Center for a Livable Future is best suited to conduct that assessment because it was central to the original work and success of the Commission.

The report that follows is an analysis by the Johns Hopkins Center for a Livable Future of the impact of the original Pew Commission recommendations, the progress toward implementation of the recommendations and the barriers encountered, and a statement of the continuing relevance of the original work.

Structure and Methods for this Report

It has been five years since the publication of the report *Putting Meat on the Table: Industrial Farm Animal Production in America* by the Pew Commission on Industrial Farm Animal Production. After a rigorous process consisting of examining technical reports from academic institutions across the country, listening to testimony from stakeholders and experts, and visiting food animal production operations in key agricultural states, the Commission developed 24 consensus recommendations for reforming food animal production in the United States. These recommendations were intended to promote the United States' ability to provide safe and affordable meat, dairy, and poultry and egg products in an environmentally and economically sustainable manner. Of these 24 recommendations, the following six were designated as priority by the Commission.

Public Health

1. Phase Out and Then Ban the Nontherapeutic Use of Antimicrobials
2. Improve Disease Monitoring and Tracking

Environment

3. Improve IFAP Regulation

Animal Welfare

4. Phase out Intensive Confinement

Rural Communities

5. Increase Competition in the Livestock Market

Research

6. Improve Research in Animal Agriculture

This report, *Industrial Food Animal Production in America: Examining the Impact of the Pew Commission's Priority Recommendations*, summarizes an assessment of the progress that has been made over the past five years toward meeting these six recommendations. For each recommendation, information on progress made as of July 2013 was assessed by examining recent legislation and regulatory efforts at the federal and state levels, reviewing scientific and gray literature, and discussing the issues with researchers, advocates, and in some cases, policymakers. This report is not a comprehensive treatment of all developments since the release of the 2008 Commission report; instead, it aims to highlight the most notable efforts to date, as well as those that exemplify the overall trends since 2008. Accordingly, several additional developments, particularly at the state level and with regard to litigation, are not fully captured here.

In some cases, legislative and regulatory actions could be clearly linked to recommendations presented in the 2008 Commission report. In other instances, no explicit connection existed, though the actions may have addressed one or more of the Commission's recommendations. Since the 2008 report helped shape the overall discourse surrounding industrial food animal production (IFAP) in the United States, we include the full range of actions that speak to the Commission's recommendations, regardless of explicit ties to the report.

The status assessment for each of the six priority recommendations is presented separately and includes the following sections:

- 1) A brief summary of the recommendation and its scientific basis; (*for further information on the original science underlying each recommendation please refer to the original Commission report*)
- 2) Recent history related to the specific Recommendation, including federal and state government efforts to bring about the recommended changes and legal challenges aimed at implementation or defeat of the recommended changes.
- 3) Conclusion

Following these six sections, the report includes an assessment regarding the overall progress made toward reforming the food animal production system in the United States.

Public Health Recommendations 1

1. Phase out and then Ban the Nontherapeutic Use of Antimicrobials

Summary and basis for recommendation

The practice of administering antimicrobials to food animals for purposes other than treatment of a diagnosed illness or control of an existing outbreak has been commonplace in IFAP for several decades. Many of the drugs used in this context are no different from those used in human medicine. In the context of food animal production, the use of antimicrobials continues to increase steadily and greatly surpasses uses in humans. Administering nontherapeutic antimicrobials to food animals is particularly problematic since chronic administration of low doses of antimicrobials contributes to the evolution and proliferation of antimicrobial-resistant strains of bacteria ³. Accordingly, the widespread use of nontherapeutic antimicrobials in animals and the selection of genes conveying resistance can vastly diminish the effectiveness of antimicrobials to treat animal and human disease ⁴.

Data on antimicrobial administration in food animal production are extremely limited. Usage data are neither collected nor reported by the Food and Drug Administration (FDA). Instead, sales data are collected from pharmaceutical manufacturers and released in summary form by the FDA on an annual basis, starting in 2009. To date, these sales data serve as the only surrogate for antimicrobial use in food animal production.

Based on FDA data, 29.9 million pounds of antibiotics were sold for use in meat and poultry production in 2011 ⁵, representing 80 percent of the total volume of antibiotics sold in the United States for any purpose ⁶. Some 685 drugs are approved by the FDA for use in animal feed ⁷. Effects from these drugs, however, reach far beyond their direct administration to food animals. The use of animal byproducts can cause the drugs to be recycled back into food production, further contributing to antimicrobial pressure on bacteria present in the food animal production setting. A recent study, for example, has shown that feather meal, a poultry byproduct used as a feed additive in poultry, swine, ruminant, and fish feed, is a source of numerous antimicrobial (and other pharmaceutical) residues ⁸. All samples tested had between two and ten measurable antibiotic residues. In addition, fluoroquinolones, a class of antibiotics banned from use in poultry in 2005, were found in the majority of samples tested.

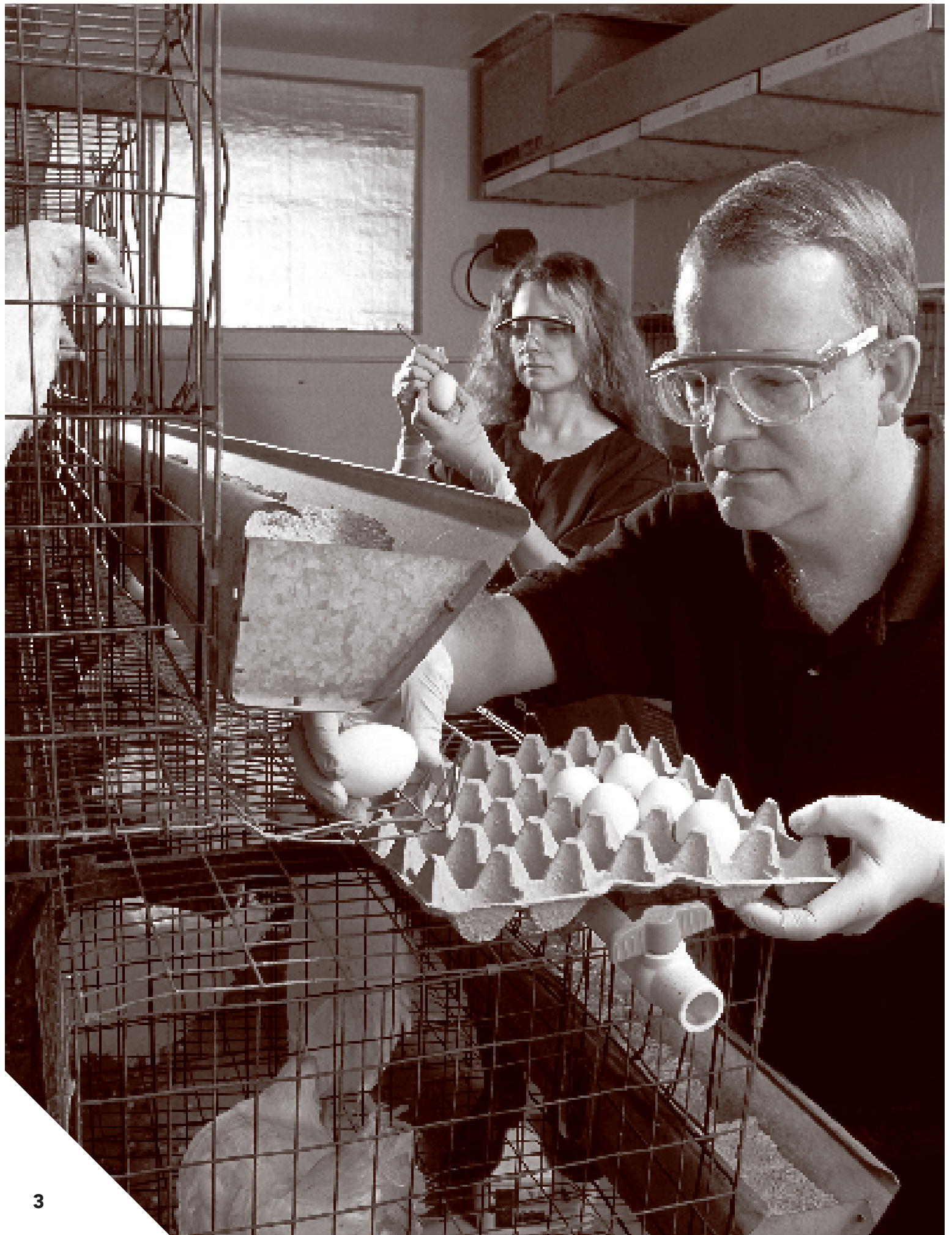
Antibiotic-resistant bacteria easily migrate from animal production sites into the air, water, and soils surrounding these sites ⁹⁻¹². They can then be transported to members of rural communities and beyond through a variety of mechanisms, including land application of animal waste

as fertilizer ¹³. Workers at IFAP operations, food animal transport trucks, and nondomesticated animals (rats, birds of prey, flies) have been shown to carry antibiotic-resistant bacteria ¹⁴⁻¹⁹; these vectors are capable of transporting bacteria off the farm site.

Humans may be exposed to antimicrobial-resistant bacteria originating from IFAP through a wide array of environmental and dietary pathways, including direct contact with animals, contact with soil, air, or water contaminated with animal waste, and consumption or handling of contaminated food ³.

Antimicrobial-resistant infections are of public health significance because they diminish the efficacy of medical treatment, resulting in increased morbidity and mortality as well as longer and costlier hospital visits ²⁰. The additional costs associated with antibiotic resistance have been studied most effectively via comparisons between methicillin-resistant *Staphylococcus aureus* (MRSA) and methicillin-sensitive *Staphylococcus aureus* (MSSA) ²¹. A study comparing hospitalization costs between patients with infections of these types found that even after accounting for the severity of the disease, the average hospitalization cost for a MRSA patient was \$45,920 compared to \$9,699 for a MSSA patient ²². A Canadian study found that MRSA infection increased hospital stays by a mean of 14 days ²³. A study of patients of the Minneapolis Veterans Affairs Medical Center found that compared to MSSA patients, MRSA patients were 12 percent more likely to die ²⁴.

After considering evidence linking animal agricultural antibiotic use practices to infection risks in humans, the



Commission recommended that the nontherapeutic use of antimicrobials begin to be phased out and eventually banned. As a first step, the Commission suggested an immediate ban on any new approvals of antimicrobials for nontherapeutic use in food animals and called for an FDA retroactive investigation of previously approved antimicrobials. Since the Commission issued this recommendation, new science has emerged that highlights the severity of the public health threat posed by this practice and reinforces the validity of the recommendation.

This section will briefly discuss key scientific developments in the understanding of the public health impacts related to the use of antimicrobials in IFAP that have occurred since the publication of the Commission report in 2008.

Antimicrobial-Resistant Bacteria in Retail Meat

The National Antimicrobial Resistance Monitoring System (NARMS) tracks antimicrobial resistance in bacteria isolated from food animals, retail meats, and humans. The FDA is responsible for testing retail meat isolates, while the U.S. Department of Agriculture and the Centers for Disease Control and Prevention focus on food animal and human isolates, respectively. NARMS is the primary source of information on antimicrobial resistance in foodborne pathogens available in the United States.

The FDA's retail meat program analyzes *Salmonella*, *Campylobacter*, *Escherichia coli*, and *Enterococcus* bacteria in collaboration with 11 state public health laboratories. Each month, participating laboratories purchase 40 meat and poultry samples, including 10 samples each of chicken breast, ground turkey, ground beef, and pork chops. All samples are cultured for *Salmonella* while only poultry (chicken breast and ground turkey) samples are cultured for *Campylobacter*. Four laboratories also culture samples for *E. coli* and *Enterococcus*. The FDA receives all bacterial isolates for analysis, including antimicrobial susceptibility testing.

NARMS has reported concerning levels of antimicrobial resistance in bacteria isolated from retail meat. In 2011, the most recent year reported, *E. coli* isolated from 37.5 percent of chicken breast samples and 64.4 percent of ground turkey samples were resistant to at least three antimicrobial classes. Similarly, 43.3 percent of *Salmonella* isolates from chicken breast, 33.7 percent of ground turkey isolates, 42.9 percent of ground beef isolates, and 50 percent of pork chop isolates were resistant to three or more classes. Similar results were reported for *Campylobacter* and *Enterococcus* isolates from chicken breast and ground turkey²⁵.

Another study, which reviewed 1,729 *E. coli* isolates from humans and food animals collected over six decades,

found that multidrug-resistant pathogens increased from 7.2 percent in the 1950s to 63.6 percent in the early 2000s²⁶.

NARMS does not monitor *Staphylococcus aureus* in retail meat, though it has announced a pilot study that would do so. Recent literature suggests that multidrug-resistant *S. aureus* (MDRSA) is prevalent in U.S. meat and poultry products. Waters et al. (2011) reported that *S. aureus* contaminated 47 percent of 136 meat and poultry samples purchased from 26 grocery stores in five cities; a majority of isolates (52 percent) were resistant to three or more antimicrobial classes²⁷. Separately, O'Brien et al. (2012) reported that 64.8 percent of 395 pork samples purchased from 36 stores in three states were contaminated with *S. aureus* and that 6.6 percent were contaminated with MRSA²⁸.

Foodborne Illness and Other Food-Related Exposures

Foodborne illness is responsible for significant morbidity and mortality in the United States, and in some cases, antimicrobial-resistant pathogens cause these illnesses. A 2013 report in *The Lancet Infectious Diseases* highlighted trends in drug-resistant *Salmonella* infections around the world and raised concerns about potentially untreatable infections in the future. Researchers estimated that these serious infections could cause an excess 1,000 deaths per year in the United States if antibiotic treatments were to become ineffective^{29;30}.

A Canadian study of *Salmonella Heidelberg* isolates from retail chicken meat and from human infections found a strong correlation in rates of resistance to cefotaxime, a cephalosporin drug that had been used in hatcheries around the time of the study. The authors asserted that cefotaxime use in poultry production selects for broad spectrum cephalosporin resistance in bacteria present on chicken meat and humans³¹.

Beyond gastrointestinal foodborne illness, a growing body of research has associated foodborne and food-related *E. coli* to urinary tract infections (UTIs), which are among the most common bacterial infections globally³². Most of the 130–175 million cases per year worldwide are caused by *E. coli*³³. In the United States, the economic burden of UTIs is approximately \$1.5 billion annually³⁴. Severe or repeated cases can cause complications including kidney damage (pyelonephritis) and blood infections (septicemia)³².

Antimicrobial treatment, which can be of limited success in treating gastrointestinal forms of *E. coli*, is critical for treating UTIs and other diseases including meningitis, pneumonia, and sepsis. Over the past several decades, multiple classes of antibiotics used to treat



UTIs have become ineffective due to resistance. Further, contaminated food sources have been implicated in outbreaks of UTIs (Nordstrom 2013).

Concern has also been raised over the continued use of arsenic-based antimicrobial drugs in food animal production³⁵. While evidence related to the environmental arsenic contribution was available at the time of the release of the previous Commission report³, new research has shown that the administration of arsenic-based drugs contributes to concentrations of arsenic in chicken meat³⁶ and liver³⁷. Residues of inorganic arsenic in edible chicken tissues increase the cancer risks of chicken consumers. While the most commonly used arsenic-based drug (roxarsone) was voluntarily suspended from sale by its manufacturer in 2011, the same sponsor continues to sell a chemically similar product (nitarosone) that is used in turkey production³⁸. Beyond direct dietary exposures, new research has shown that feather meal, as a feed additive for poultry, swine, ruminants, and fish, is a mechanism for cycling arsenic through the animal production system³⁹.

Occupational Exposures

Since the publication of the Commission report, new research has demonstrated that the workplace is a site of antibiotic-resistant pathogen exposure for IFAP workers³. Much of this research has focused around characterization of *S. aureus* in swine production.

A study of nasal swabs taken from animals and workers at 45 swine operations (21 antibiotic-free and 24 conventional) in Illinois, Iowa, Minnesota, North Carolina, and Ohio used molecular characterization to examine rates of carriage of livestock associated MRSA (LA-MRSA). Carriage of LA-MRSA was documented in workers and pigs at conventional farms but was not found in any nasal swabs from antibiotic-free operations^{14;15}.

A 2013 study examining workers at industrial livestock operations (with nontherapeutic antimicrobial use) and antibiotic-free livestock operations in North Carolina found similar carriage rates of *S. aureus* and MRSA among workers of both types of operations, but only found livestock-associated MRSA and MDRSA in the nasal passages of industrial livestock operation workers¹⁵.

In addition to studies of IFAP workers, new research has shed light on the origins of LA-MRSA. An international team used whole genome sequence testing to trace the lineage of MRSA clonal complex 398 (CC398), widely recognized as an important strain of LA-MRSA, through the examination of the genomes of 89 CC398 isolates from a wide array of animal and human settings⁴⁰. Using this specialized tool, the authors found that MRSA CC398 likely originated as a methicillin-susceptible form of *S. aureus* in humans, was transferred to swine

populations where it acquired methicillin resistance due to antibiotic pressure from routine antibiotic use, and was returned to human populations as a drug-resistant strain.

Community and Environmental Exposures

Additional evidence has been generated regarding risks to rural communities posed by antibiotic-resistant bacteria originating at food animal production sites. A large fraction of the antimicrobials fed to farm animals is excreted unaltered (up to 75 percent) and may remain in soil following land application of manure. Antimicrobials and antimicrobial-resistant pathogens can also persist in water, as they are typically not removed completely in wastewater treatment and can be re-released to the environment⁴¹. Studies in China have identified antibiotic resistance genes in water, sediment samples, and fields next to swine feedlots^{41;42}.

A recently published study used electronic health records and data from nutrient management plants to examine spatial relationships between animal production sites and crop field manure exposure and community associated MRSA (CA-MRSA) and skin and soft tissue infection (SSTI). The study found associations between geographic proximity to swine manure application (spray fields) and high-density livestock facilities to CA-MRSA and SSTI. This research suggests that the environmental presence of swine manure and IFAP facilities provides a pathway to antimicrobial-resistant human infections⁴³. The study also concluded that more than 10 percent of CA-MRSA would be prevented if exposures to swine waste applied to cropland were eliminated. A different study of clinically diagnosed MRSA patients found that patients living in areas with higher livestock density were more likely to have LA-MRSA than other types of MRSA⁴⁴.

Summary of New Evidence

Since the Commission's 2008 recommendations to phase out and ban the nontherapeutic use of antimicrobials in farm animals, additional scientific evidence has strengthened the case that these uses pose unnecessary and unreasonable public health risks and have economic consequences. As discussed above, antimicrobial-resistant pathogens can transfer between animals and humans; food-related, environmental, and community exposures contribute to the burden of antimicrobial-resistant infections in humans. Gastrointestinal foodborne illness, MRSA, UTIs, and arsenic-related disease are several of the human health concerns associated with nontherapeutic antimicrobial use in IFAP. Further, from countries that have limited or banned antimicrobial use, we have learned that withdrawal of antimicrobials as growth promoters results in reduced rates of resistance in food animal isolates²⁹. This change in policy is possible without reducing rates of production when combined with more frequent

cleaning of animal housing and reduction in animal crowding, as has been seen in the Danish swine industry; since 1994, the Danish industry has seen antibiotic use fall from more than 25 mg to 10 mg of antibiotic per kg of meat produced, all while increasing overall production by about 10 million pigs annually ⁴⁵.

Recent history related to the recommendation

Federal Legislative Efforts

Preservation of Antibiotics for Medical Treatment Act (1999 to present)

The Preservation of Antibiotics for Medical Treatment Act (PAMTA), currently sponsored by Rep. Louise Slaughter (D–NY), and its Senate companion bill, the Preventing Antibiotic Resistance Act, currently sponsored by Sen. Dianne Feinstein (D–CA), would require the FDA to withdraw approvals of nontherapeutic uses of medically important antimicrobials in food animals, except where a company holding an approval demonstrates with reasonable certainty that the nontherapeutic use of the drug will not harm human health by promoting the development of antimicrobial resistance ^{46; 47}. These bills would also require a company seeking a new approval of a nontherapeutic use of a medically important antimicrobial to make the same demonstration; otherwise, approval would be denied.

Because most approvals of nontherapeutic uses are unlikely to meet this standard, enactment of PAMTA would probably result in the withdrawal of most such approvals, effectively implementing the Commission's recommendation with respect to nontherapeutic antimicrobial use. More than 450 public health, medical, and other organizations have endorsed the legislation ⁴⁸. Unfortunately, however, PAMTA has failed to pass either house of Congress in the 14 years since its initial introduction and is not expected to pass soon.

Notably, the definition of “nontherapeutic use” contained in PAMTA broadly aligns with the definition recommended by the Commission. In its 2008 report, the Commission defined “nontherapeutic” use as “any use of antimicrobials in food animals in the absence of microbial disease or known [documented] microbial disease exposure” (p. 63). This definition explicitly included use of an antimicrobial for growth promotion, feed efficiency, weight gain, or routine disease prevention, all of which the Commission considered to be nontherapeutic uses.

PAMTA defines “nontherapeutic use” as any use of an antimicrobial except “for the specific purpose of treating an animal with a documented disease or infection” (meaning that microbial disease is present) or in “an animal that is not sick but where it can be shown that a particular disease or infection is present, or is likely to occur” (implying that a microbial disease exposure has transpired) ^{46; 47}. Importantly, the disease or infection

in question cannot be present or likely to occur because of standard production practices or conditions. In accordance with the Commission's report, PAMTA explicitly designates growth promotion, feed efficiency, weight gain, and disease prevention as nontherapeutic uses.

Animal Drug User Fee Amendments of 2008

In sharp contrast to countries such as Denmark where antimicrobial use can be traced to individual producers ⁴⁵, comprehensive data on antimicrobial use in U.S. food animals are not collected. The only comprehensive data that exist in the United States are antimicrobial sales data reported by drug companies to the FDA under Section 105 of the Animal Drug User Fee Amendments of 2008 (ADUFA) ⁴⁹.

Because the 2008 legislation reauthorizing ADUFA was considered “must-pass” by both the FDA, which derives significant salary support from the user fees authorized under the law, and by the drug industry, which receives swifter review of new animal drugs as a result, the late Sen. Edward Kennedy and Sen. Sherrod Brown sought to implement the Commission's recommendation by including PAMTA in the bill. Following claims that more research was necessary to support restrictions on antibiotic use, the inclusion of PAMTA was scrapped in favor of the current reporting requirements. These requirements were intended to collect data in support of Congressional action, but such action has not been forthcoming.

ADUFA directs the agency to publish annual summaries of reported data. In some cases, sales data may be used as surrogates for antimicrobial use. Unfortunately, the FDA withholds the vast majority of data reported by companies. In the three years for which reports are available (2009–2011), the agency has included only domestic and export sales by antimicrobial class ⁵⁰. The sales of classes for which fewer than three companies actively market an antimicrobial are not reported separately; rather, they are aggregated into a “not independently reported” category. This format severely limits the utility of the summaries.

ADUFA must be reauthorized by Congress every five years ⁴⁹. The statute directs the FDA to negotiate recommendations for reauthorization with drug companies and to solicit public comments on these recommendations as well. During the 2013 reauthorization, a number of advocacy groups, professional associations, and academic researchers urged the agency to recommend enhancements to the antimicrobial sales reporting requirements ^{51; 52}. As in 2008, ADUFA reauthorization was considered must-pass and therefore was seen as an opportunity to enact enhancements to reporting that the drug industry might oppose otherwise. These requests were to no avail, however; the FDA did not include any enhancements in its recommendations to Congress ^{53; 54}. Rather, the agency separately solicited

public comment on enhancements to the annual summaries as part of a public comment period on an “advance notice of proposed rulemaking” (see below).

ADUFA was reauthorized in June 2013 without any changes to the reporting requirements of Section 105; reauthorization is next required in 2018 ⁵⁵.

Delivering Antibiotic Transparency in Animals Act (2013 to present)

The Delivering Antibiotic Transparency in Animals (DATA) Act, sponsored by Rep. Henry Waxman (D–CA), would amend the reporting requirements contained in ADUFA Section 105 to require drug companies to report additional sales data, and to require integrators to report data on antimicrobial use ⁵⁶. The bill would also direct the FDA to include additional information on reported data in the annual summaries, including breakdowns by route of administration and approved indication, animal species, and production class. The legislation, which was introduced in February 2013 prior to reauthorization of ADUFA, has not been enacted.

Antimicrobial Data Collection Act (2013 to present)

The Antimicrobial Data Collection Act, sponsored by Sen. Kirsten Gillibrand (D–NY), would, like the DATA Act, require the FDA to include additional information on antimicrobial sales data in the annual summaries required under ADUFA ⁵⁷. It would not, however, require any additional reporting of sales by drug companies or require reporting of antimicrobial use by integrators. It has not been enacted.

Federal Regulatory Efforts

To date, limited federal regulatory activity has occurred since the release of the Commission report. The majority of activity has focused on a series of voluntary FDA guidance documents focused on antibiotic use.

Guidance Documents

The FDA has pursued a voluntary and partial approach to restricting nontherapeutic antimicrobial use. In April 2012, the agency issued one guidance document and published a draft of a second guidance document that together urge drug companies to voluntarily withdraw approvals to market antimicrobials for certain nontherapeutic uses (i.e., growth promotion) while maintaining and likely adding approvals to market these drugs for other nontherapeutic uses (i.e., preventive or chemoprophylaxis use). (Notably, the FDA considers the

latter nontherapeutic uses to be therapeutic, though its use of the term is inconsistent with the Commission’s recommendation, as explained below.)

In April 2012, FDA issued *Guidance for Industry #209: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals*, which presented two recommendations ⁵⁸. First, antimicrobial use “should be limited to those uses that are considered necessary for assuring animal health.” This includes “uses that are associated with the treatment, control, or prevention of specific diseases” but does not include “production purposes (i.e., to promote growth or improve feed efficiency)” (p. 21). Second, antimicrobial use “should be limited to those uses that include veterinary oversight or consultation” (p. 22).

When the FDA issued Guidance 209 in April 2012, it simultaneously published a draft of *Guidance for Industry #213: New Animal Drugs and New Animal Drug Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations for Drug Sponsors for Voluntarily Aligning Product Use Conditions with GFI #209* ⁵⁹. Guidance 213 is intended to implement the recommendations contained in Guidance 209 by requesting that drug companies voluntarily withdraw approvals to market antimicrobials for use in animal feed and drinking water for “production purposes” such as growth promotion and feed efficiency. It also requests that companies voluntarily amend approvals to market antimicrobials over the counter so that a veterinary prescription or veterinary feed directive (see next section) is required to purchase and use these drugs in feed and water. Guidance 213 requests that companies complete voluntary withdrawals and amendments within three years of the finalization of Guidance 213, which is expected soon.

The voluntary guidance documents are inconsistent with the Commission’s recommendation that nontherapeutic use of antimicrobials in food animals be phased out and eventually banned. Most importantly, while the FDA has recommended that “production uses” be discontinued, it has endorsed the continued use of antimicrobials for routine disease prevention, which the Commission explicitly mentioned as an example of nontherapeutic use. Notably, Guidance 213 provides for the replacement of production approvals with disease prevention approvals, something that the drug industry has said it will pursue. In many cases, the doses and durations of antimicrobial use for disease prevention are similar or even identical to the doses and durations utilized for production purposes. This means that while antimicrobial approvals may change under Guidance 209 and Guidance 213, antimicrobial use may not.

The voluntary approach has come under withering criticism from the public health, medical, and other communities concerned about the increase in antibiotic-resistant bacterial pathogens. Many have highlighted the

loophole that could allow disease prevention approvals to replace production approvals without altering actual use or selection for antimicrobial resistance^{60,61}. Some have also criticized the reliance on a voluntary approach in place of regulation (i.e., withdrawal proceedings)^{62,63}. These problems are interrelated: Voluntary action by drug companies depends on the companies' ability to replace withdrawn production approvals with new prevention approvals and thereby maintain current sales and use⁶⁴.

Veterinary Feed Directive Regulation

A veterinary feed directive (VFD) is essentially a veterinary prescription for a drug administered in feed. Guidance 213 requests that drug companies voluntarily amend current approvals to market in-feed antimicrobials over the counter so that a VFD is required for their use. Simultaneously, the agency is amending the requirements for issuing a VFD, ostensibly to "streamline" the process and encourage the transition from over-the-counter (OTC) to VFD status under the guidance document⁶⁵. The FDA published a draft proposed rule in April 2012 and received comments on it. The agency will next publish a proposed rule and receive additional comments. Finally, the proposed rule will be finalized with any changes made by the FDA.

The Commission recommended increasing veterinary oversight of all antimicrobial use in food animal production. Unfortunately, while Guidance 213 may result in transitioning antimicrobials used in medicated feed from OTC to VFD status, thereby increasing veterinary oversight, changes to the VFD requirements could weaken significantly the meaning and value of such oversight. Most importantly, the draft proposed rule removes the requirement that a VFD only be issued in the context of a valid veterinarian-client-patient relationship (VCPR)⁶⁶. A VCPR exists when the veterinarian, among other things, has recently seen and is personally acquainted with the keeping and care of animals. The removal of the VCPR requirement may allow veterinarians (such as those employed by large integrators) to issue a VFD to an operation without having visited the operation recently and without having examined the animals.

Cephalosporins

In April 2012, the FDA banned certain extra-label uses of cephalosporins⁶⁶. (An extra-label use is an unapproved use of a drug approved for other conditions.) The ban followed the publication of studies finding that certain extra-label cephalosporin uses, especially the prophylactic injection of chicken eggs at hatcheries, promoted cephalosporin resistance in *Salmonella*. Cephalosporin resistance in these bacteria is concerning because cephalosporins are the drugs of choice for treating salmonellosis in pediatric settings; the drugs of choice in adult patients, fluoroquinolones, cause severe side effects in children. The

2012 extra-label use ban came after the FDA withdrew a more comprehensive ban proposed in 2008 following opposition from industry⁶⁷.

Advance Notice of Proposed Rulemaking

In August 2012, the FDA issued an advance notice of proposed rulemaking (ANPR) and solicited public comments on multiple issues related to data on antimicrobial sales and use. The agency stated that it intended to consider these comments as it identified approaches to collecting additional data⁶⁸. During ADUFA reauthorization, when public health advocates urged the agency to recommend enhancements to the reporting requirements enacted under ADUFA in 2008, the agency claimed that it would pursue any such enhancements separately following consideration of comments on the ANPR. This engendered skepticism among public health stakeholders, as the ANPR appeared to be merely a means to deflect criticism of agency inaction on antimicrobial resistance during the reauthorization process.

State Legislative Efforts

Legislation that would ban the nontherapeutic use of antimicrobials in food animals or require the labeling of meat and poultry produced with these drugs has been introduced in multiple states, including California, Minnesota, Maryland, New York, and Pennsylvania. None of the bills has passed. In addition to opposition from the drug and food animal industries, opposition from state agencies has been reported. Ban and labeling bills, for example, that were introduced in Maryland in 2013 were opposed by the Maryland Department of Agriculture⁶⁹.

Maryland Arsenical Antimicrobial Drug Ban

On January 1, 2013, Maryland became the first state to prohibit the use of roxarsone and most other antimicrobial arsenical drugs in chicken feed⁷⁰. Nitarsone, an arsenic-based drug approved for use in chicken and turkey production, was exempted from the ban. Several other states are now considering similar legislation, including New York⁷¹ and Vermont⁷².

State Regulatory Efforts

We could not find evidence of state regulatory measures to control antimicrobial use in food animal production.

Litigation

Natural Resources Defense Council v. Food and Drug Administration

In May 2011, the Natural Resources Defense Council (NRDC) and others sued the FDA, alleging that the agency was obligated to withdraw approvals to market penicillin and tetracyclines for nontherapeutic purposes following a 1977 finding that these approvals were not shown to be safe⁷³. The plaintiffs further alleged that the FDA's failure to respond to two citizens' petitions for the withdrawal of nontherapeutic approvals that were submitted in 1999 and 2005 was unlawful. Although the 180-day deadline for agency responses to such petitions seldom is met, the 12 and six years that these petitioners had waited exceeded typical delays.

The FDA responded by attempting to avert both claims, first by denying (and thereby responding to) both petitions in November 2011 and then by withdrawing the 1977 findings during the following month⁷⁴⁻⁷⁶. In both cases, the agency claimed that withdrawal proceedings would be too costly and take too long while reiterating that it intended to address certain nontherapeutic approvals as described in the voluntary guidance documents (see above). The plaintiffs amended their complaint to challenge the denials of the petitions as "arbitrary and capricious" because they did not address either petition on its merits, focusing instead on agency resources.

In March 2012, a U.S. magistrate judge ruled that the FDA's failure to pursue withdrawals of penicillin and tetracycline approvals following the 1977 findings constituted an agency action unlawfully withheld and ordered the agency to reissue its findings and initiate withdrawal proceedings^{63;77}. In June 2012, the same judge ruled that the denials of the petitions were arbitrary and capricious and remanded them to the agency for review on their merits^{62;78}. The FDA has appealed both decisions; briefing and oral arguments in the appeal concluded in February 2013. A decision is expected soon.

Government Accountability Project v. Food and Drug Administration

As mentioned above, there have been a number of unsuccessful efforts to access additional antimicrobial sales data that the FDA collects under ADUFA but does not share with the public. Efforts to amend ADUFA during the 2013 congressional reauthorization were unsuccessful. Meanwhile, the agency has announced that it will reformat annual summaries of these data starting this year, but these remain subject to a number of constraints.

In early 2011, the Johns Hopkins Center for a Livable Future (CLF) approached the Government Accountability Project (GAP) for assistance in obtaining additional sales data. GAP submitted a Freedom of Information

Act (FOIA) request to the FDA⁷⁹. The agency denied the request, claiming that the requested data were "confidential commercial information" and therefore exempt from disclosure under FOIA (the statute contains a number of such exemptions). GAP appealed administratively to the Public Health Service (PHS), a division of the Department of Health and Human Services that includes the FDA. The PHS denied the appeal in September 2012, likewise holding that the data were confidential commercial information.

In December 2012, GAP filed a complaint in U.S. district court, alleging that the FDA had inappropriately denied the request for additional data⁷⁹. In the FDA's motion for summary judgment, submitted in July 2013, the agency relied on affidavits from 13 drug companies that oppose the release of additional sales data. It is likely that companies' opposition to the release of sales data is based on a desire to avoid heightened scrutiny of their products. Briefing on summary judgment will conclude in September 2013, with a decision to follow.

Lawsuits Relating to Arsenical Use

In 2013, two lawsuits were filed relating to the FDA's continued approval for the use of arsenic-based antimicrobial drugs in animal feed. After petitioning the FDA in 2009 to withdraw approvals for arsenic-based drugs in food animal production, the Center for Food Safety, the Institute for Agricultural and Trade Policy (IATP), and seven other groups filed suit in 2013 for not responding to their petition⁸⁰. In a separate suit, Food and Water Watch brought charges against the FDA for failing to respond to a Johns Hopkins Center for a Livable Future FOIA request for communications made between the agency and the Pfizer pharmaceutical company (which manufactures the arsenic-based drugs roxarsone and nitarosone) with regard to arsenical drugs⁸¹. As of September 2013, both lawsuits were pending.

Voluntary Industry Efforts

Suspension of Roxarsone by Pfizer

In June 2011, the FDA announced that Pfizer was voluntarily suspending domestic sales of the arsenic-based drug roxarsone. This action was taken after the FDA advised Pfizer of a new agency-conducted study that found that levels of inorganic arsenic in the livers of roxarsone-treated chickens compared to those in untreated chickens⁸². Despite the findings of its study, the FDA did not formally withdraw the approvals for roxarsone or other arsenic-based drugs. Consequently, Pfizer may reintroduce the drug into the market at will. Further, Zoetis (formerly Pfizer Animal Health) currently markets nitarosone domestically and continues to sell roxarsone outside the United States³⁶.





Conclusions

Evidence linking antibiotic misuse in IFAP to environmental transport of and human infection with antibiotic-resistant bacteria continues to accumulate. Despite the sizable body of literature supportive of a decision to eliminate antimicrobial use outside the context of veterinarian-diagnosed disease, little progress has been made to change patterns of use. While some meager success has been achieved (in the form of the ban of off-label uses of cephalosporins), the voluntary approach preferred by the FDA and the lack of willingness by the industry to alter its behavior suggest that meaningful change is unlikely in the near future. Similarly, in the case of arsenic-based drugs, the evidence linking use of these compounds to dietary and environmental arsenic exposures has become far stronger. Even with new evidence, the FDA has not taken action to remove these drugs from the domestic market.

Public Health Recommendations 2

2. Improve Disease Monitoring and Tracking

Summary and basis for recommendation

Citing the importance of an accurate trace-back system in the event of a zoonotic disease outbreak, the Commission recommended that a disease monitoring program, accompanied by an animal-specific tracking system, be put in place to allow for a 48-hour traceback of food animals at every stage of production. It identified an existing voluntary system for animal tracking put in place by the USDA Animal Plant and Health Inspection Service (APHIS), but proposed that a plan for a mandatory animal- or lot-based tracking system be established by 2009, with implementation scheduled for 2010. The Commission also recommended federal regulatory oversight of such a tracking system, along with financial assistance for smaller producers in pursuit of compliance.

Recent History Related to the Recommendation

Federal Legislative Efforts

Meat Safety and Accountability Act of 2010

In 2010, Sen. John Tester (D-MT) introduced the Meat Safety and Accountability Act⁸³, which calls for contaminated meat products to be traced back to the original source of contamination, including preparation, processing, and slaughtering facilities, as well as for testing practices at meat suppliers and processors to be improved. While the bill had support among food safety advocates⁸⁴, the legislation died in committee.

Food Safety Modernization Act of 2011

President Obama signed the Food Safety Modernization Act (FSMA) into law in 2011, instructing FDA to devise regulatory approaches to ensure the safety of the nation's food supply from farm to fork. While the safety of the majority of animal products (aside from seafood) is outside FDA's jurisdiction, the agency is responsible for produce safety. Given the frequency with which animal waste is used as fertilizer in the production of fruits and vegetables, concerns exist regarding the potential transport of pathogens present in animal waste¹³ to crops intended for human consumption. Among the mandates placed upon FDA in FSMA are those related to enhanced tracking and traceability of food, along with calls for improved record keeping⁸⁵. In response to this mandate, FDA initiated pilot projects to aid it in assessing best practices for product tracing, and published a document describing

lessons learned in March 2013⁸⁶. After soliciting feedback on this document, the agency will initiate rule making on high-risk foods to facilitate product tracing⁸⁷.

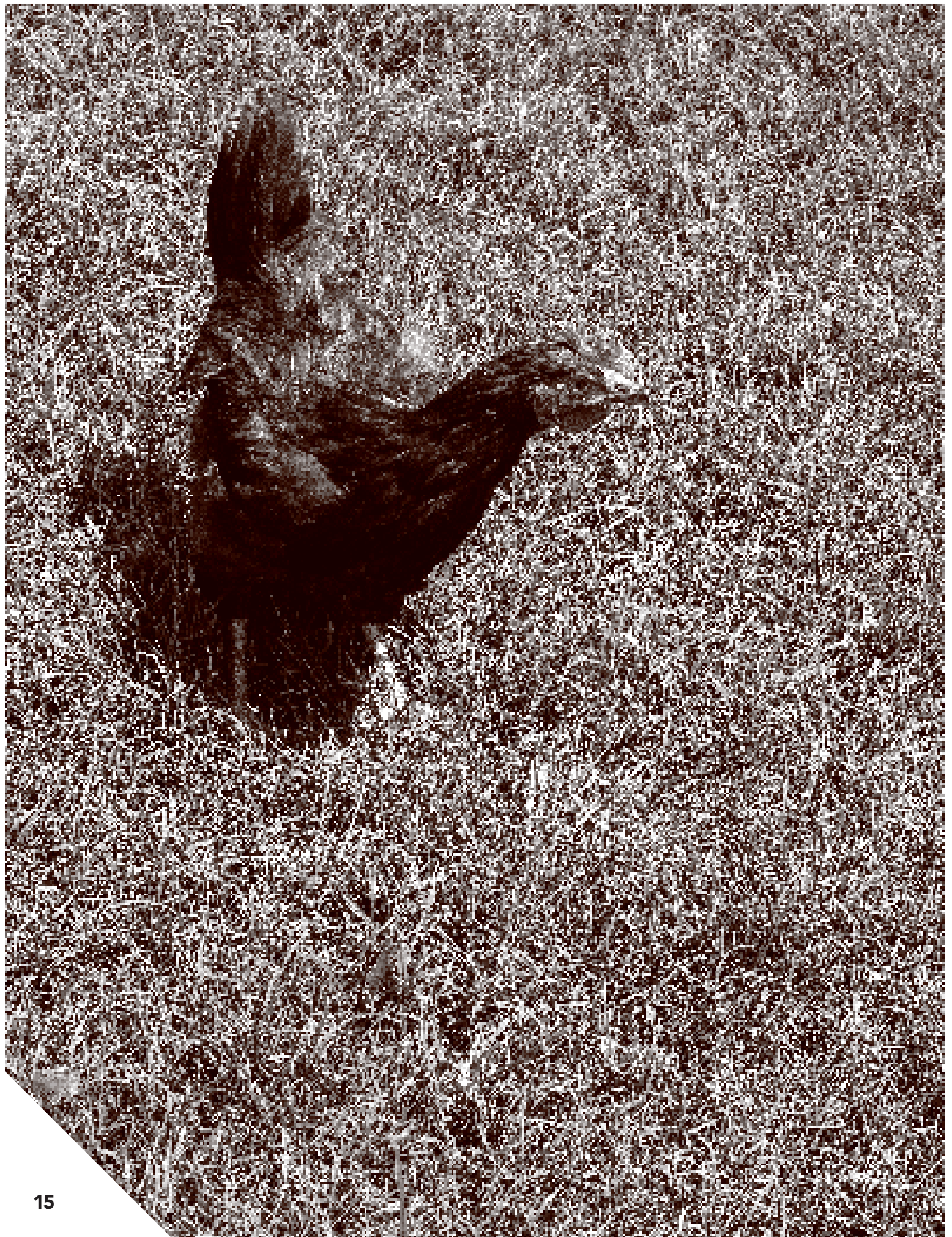
Federal Regulatory Efforts

National Animal Identification System (NAIS)

When the Commission report was released, the USDA's APHIS was attempting to implement the voluntary National Animal Identification System (NAIS). This effort relied on producers registering their premises and identifying their animals in a national animal-tracking database, with the goal of being able to quickly identify outbreaks of infectious disease in livestock. In response to continued low NAIS enrollment in 2009, APHIS held a series of "listening sessions" on animal identification to clarify any issues or concerns with the program⁸⁸. After a large number of producers voiced significant concerns with NAIS, the program was never fully implemented and was ultimately discontinued in 2012⁸⁹. Particular concerns arose with regard to privacy, a lack of flexibility, and excessive costs for smaller producers.

Animal Disease Traceability Final Rule

Following the discontinuation of NAIS, APHIS has worked to develop a new approach to tracing animals. In January 2013, the USDA issued a final rule on animal disease traceability⁹⁰. This revised strategy addresses many of the concerns associated with NAIS, and also reflects both feedback from public meetings held on the issue in 2010 and comments made on an initial rule proposed in August 2011⁸⁹. In a significant departure from NAIS, the



new rule applies only to animals moving interstate, and tracing data will be maintained by states rather than in a centralized database. Additionally, the proposed provisions are no longer voluntary, requiring instead that specified livestock species that are moved interstate be officially identified and accompanied by an interstate certificate of veterinary inspection or other documentation agreed upon by shipping and receiving states. APHIS notes that the rule is not focused on food safety and that “animal disease traceability ends when an animal is slaughtered.” The final rule became effective March 11, 2013.

Changes to FSIS Food Safety Tracing of Meat Products

The USDA’s Food Safety and Inspection Service (FSIS), which regulates meat, poultry, and egg products (eggs that have been removed from shells), has undertaken numerous efforts since 2008 to improve procedures for tracing contaminated meat. In March 2010, FSIS held a public meeting to discuss its efforts to improve tracebacks for products contaminated with *E. coli*. In response to comments from this meeting, FSIS revised its inspection procedures in 2012 so that personnel gather supplier information each time they sample ground beef or bench trim (the fat or meat removed at the processing plant) for *E. coli*, rather than waiting until they have a positive test result to gather supplier information⁹¹. This change allows FSIS to identify suppliers more rapidly in the case of positive test results. In the same year, FSIS further expedited its process by beginning tracebacks to identify suppliers and processors based on presumptive positive test results for *E. coli* instead of waiting for confirmed positive results⁹².

Additionally, FSIS issued three final rules in response to 2008 Farm Bill provisions. Specifically, the new rules require establishments to 1) prepare and maintain recall procedures, 2) notify FSIS within 24 hours that a meat or poultry product that could harm consumers has been shipped into commerce, and 3) document reassessments of their hazard control and critical control point system food safety plans⁹².

State Legislative Efforts

Texas Animal ID Law

At the state level, a 2013 animal identification law in Texas has been drawing many of the same criticisms that were voiced about the National Animal Identification System. The legislation, which was signed into law in May 2013, allows (but does not require) the Texas Animal Health Commission (TAHC) to develop and implement a state animal identification system that is “no more stringent than a federal animal identification program”⁹³. In the event that a two-thirds vote by the TAHC can be achieved, the law permits the commission to have a more

stringent program “only for control of a specific animal disease or for emergency animal management.” Advocates and groups representing small-scale farmers have indicated significant concern that the legislation would be prohibitively cumbersome and expensive for small farmers and individuals raising backyard chickens⁹³.

State Regulatory Efforts

We could not find evidence of state regulatory measures to implement animal disease monitoring or tracking.

Voluntary Industry Efforts

We could not find evidence of industry measures to implement animal disease monitoring or tracking.

Conclusion and Progress to Date

Limited meaningful activity has occurred in the domain of zoonotic disease monitoring and tracking since the Commission issued its recommendations in 2008. While a few federal initiatives that held promise were initially promoted, pushback from the agricultural industry has resulted in the dropping or significant weakening of these approaches. Consequently, it is not expected that measurable changes in rates of foodborne illness resulting from contaminated animal products will be observed. Upcoming regulations addressing produce safety under FSMA may, however, result in process controls and checks that can limit the frequency or reduce the impact of infectious disease outbreaks stemming from contaminated produce. The true impact of these regulations remains to be seen, as draft regulations addressing traceability have yet to be released.

Environmental Recommendation

3. Improve IFAP Regulation

Summary and basis for recommendation

As the number of animals on farms has grown and animal production facilities have become increasingly concentrated geographically, significant problems related to the storage and disposal of manure have been documented ^{13; 35}. The USDA estimates that more than 335 million dry tons of manure are produced yearly in the United States ⁹⁴. Nutrients from excessive manure application (and dumping) can enter ground and surface waters, leading to significant environmental and public health concerns. IFAP facilities can also contaminate water supplies with chemicals present in pesticides ⁹⁵, antibiotics ⁹⁶, hormones ⁹⁷, and heavy metals ³⁵, as well as pathogens ¹⁰ and antibiotic resistance genes ⁹⁶. Food animal production sites and waste storage facilities have also been shown to be responsible for releases of air pollutants, including ammonia ⁹⁸, hydrogen sulfide ⁹⁹, pathogens ¹¹, endotoxins ¹⁰⁰, and animal dander ¹⁰¹.

In light of the air and water pollution stemming from IFAP facilities (and the corresponding potential for human exposure), the Commission recommended that IFAP be regulated in a manner similar to that of other industrial operations. To accomplish this, the Commission noted that the current patchwork of laws and regulations dealing with farm waste should be replaced with new laws and regulations outlining baseline waste-handling standards for these facilities. These standards should specify the regulations that states must put into place to prevent pollution from IFAP facilities.

Recent History Related to the Recommendation

Federal Legislative Efforts

Proposed Amendments to Block FOIA Requests of Farmer Data

In 2013, Sen. Chuck Grassley (R-IA) proposed amendments to limit the EPA's ability to respond to FOIA requests about livestock producers ^{102; 103}. The provisions would prevent the disclosure of even the most basic information about producers or the location of their facilities. Sen. Grassley introduced these measures in response to the EPA's controversial release of personal information (including names, contact information, and geographic locations) on livestock producers to advocacy groups in February 2013 ¹⁰⁴. Grassley initially discussed offering the EPA amendment during the Farm Bill debate but ultimately decided against doing so. Instead, he introduced a stand-alone bill in July 2013 ¹⁰⁴.

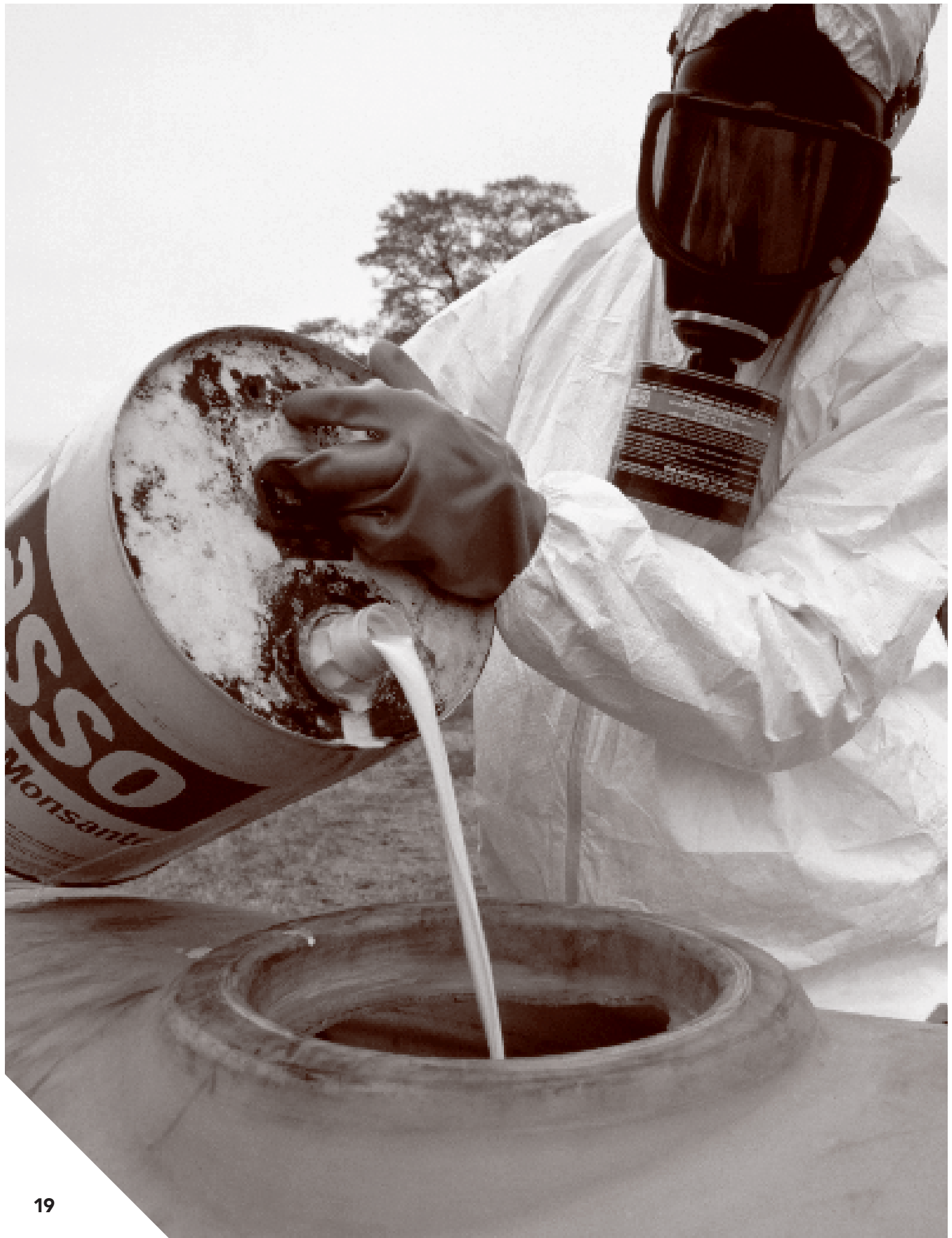
Farm Dust Regulation Prevention Act of 2011

In 2011 Rep. Kristi Noem (R-SD) introduced The Farm Dust Regulation Prevention Act, which would have exempted particulate matter generated by agricultural activities from regulation under the Clean Air Act. If passed, the bill would have prevented the EPA from issuing any new rules regulating coarse particulate matter for a one-year period. The introduction of the bill was met with criticism from the public health community ¹⁰⁵. While this effort was passed by the U.S. House of Representatives, it did not pass the Senate and therefore did not become law. The effort was significant, however, because it exemplified the push for legislation that preempts agricultural reforms. This effort was also notable because the EPA had not made any attempt to regulate farm dust.

Federal Regulatory Efforts

Changes to Regulations on National Pollutant Discharge Elimination System Permits

On October 31, 2008, the EPA issued a final rule on effluent discharges and nutrient management of CAFOs. These new regulations were revised from original 2003 rules after the 2005 *Waterkeeper Alliance et al. v. EPA* decision. The final ruling on this case in the U.S. Court of Appeals for the Second Circuit included two major changes to the 2003 rules. First, the regulations required only CAFOs that discharge or intend to discharge waste



to apply for National Pollutant Discharge Elimination System (NPDES) permits. Before the decision, the rule had required all CAFOs to apply for permits. Second, the new rules required CAFOs to submit Nutrient Management Plans (NMPs) along with their NPDES permit applications.

Soon after the establishment of these regulations, the National Pork Producers Council, along with nine other groups representing pork, chicken, dairy, and egg industries, appealed to the U. S. Court of Appeals regarding the CAFO regulations. In *National Pork Producers Council v. EPA*, the court ruled on March 15, 2011, that only CAFOs that actually discharge into waters must apply for NPDES permits, thereby omitting CAFOs that *intend* to discharge into waters from regulation¹⁰⁶. In July 2012, a new final rule excluding the vacated provisions requirements for CAFOs that intend to discharge into waters was issued.

EPA Withdrawal of Proposed CAFO Reporting Rule

As a part of a 2010 settlement with the Waterkeeper Alliance, Natural Resources Defense Council, and Sierra Club, in 2011 the EPA proposed a new rule seeking to obtain basic operational information from CAFOs to assist with the enforcement of EPA water quality standards under the Clean Water Act¹⁰⁷. After the public comment period, however, the EPA withdrew the proposed CAFO data collection rule in 2012. As there is no requirement for CAFOs to submit this information to the EPA under current regulations, the agency noted that it plans to rely on existing sources to obtain this information¹⁰⁶.

In response to this action, the Natural Resources Defense Council, Earthjustice, and the Pew Charitable Trusts filed Freedom of Information Act (FOIA) requests for further information on the withdrawal of the reporting rule and EPA's currently available information on CAFOs and their locations^{108, 109}. The EPA initially approved this request and released the information in February 2013; however, this decision was met with substantial backlash by industry and Congress¹¹⁰⁻¹¹². The EPA subsequently requested that the organizations return the CAFO data, and it distributed new data sets with the personal information of farmers redacted¹⁰⁸.

CERCLA/EPCRA Reporting Exemption for Air Releases of Hazardous Substances from Animal Waste at Farms

In a development counter to the Commission's recommendation that IFAP be regulated in a manner similar to that of other industrial operations, a new EPA rule exempting IFAP facilities from air pollutant reporting requirements under two key federal statutes came into effect in January 2009. The two statutes in question, the

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Emergency Planning and Community Right to Know Act (EPCRA), are intended to ensure that federal, state, and local authorities are notified about releases of substances dangerous to human health and the environment.

Under this new rule: 1) *all* farms (including AFOs) that release hazardous substances from animal waste to the air are indefinitely exempt from reporting under CERCLA provisions; and 2) farms under a certain size that release hazardous substances from animal waste to the air are exempt from reporting under EPCRA provisions¹¹³. In addition, as part of an agreement with AFOs that signed a consent agreement in 2005 to fund the National Air Emissions Monitoring Study (NAEMS), the EPA has said it would not sue for civil violations of EPCRA and CERCLA reporting requirements. These operations (more than 13,000 AFOs) are thus not expected to make reports at this time¹¹³. In justifying its decision, the EPA noted that it could not "foresee a situation where the Agency would initiate a response action as a result of [a CERCLA] notification"¹¹⁴. Both environmental and industry groups challenged this rule in 2009, but an updated rule has not yet been proposed. In 2011, industry advocates also attempted, unsuccessfully, to permanently exempt manure from CERCLA through the Superfund Common Sense Act.

National Air Emissions Monitoring Study (NAEMS)

In 2005, the National Air Emissions Monitoring Study was established through an Air Quality Compliance Agreement with animal producers. In return for paying a civil penalty, as well as funding and participating in the study, the EPA agreed not to sue participants for certain past and study-period violations of the Clean Air Act, CERCLA, and EPCRA¹¹⁵. Participants of the Compliance Agreement are currently not expected to make reports under EPCRA¹¹⁴. The study was intended to provide the EPA with data needed to develop a procedure for estimating emissions from IFAP facilities. These methodologies are in turn intended to help the EPA determine the air compliance status of facilities¹¹⁶. Participating facilities are obligated to use the methodology developed and apply for a permit under the Clean Air Act if they exceed emissions thresholds¹¹⁶.

NAEMS was conducted as an EPA/industry partnership. In addition to the funding from specific operations, industry trade organizations—the National Pork Board, the National Chicken Council, the National Milk Producers Federation, and the American Egg Board—also provided funding. Purdue University led the study, with assistance from other land grant universities¹¹⁷. The study has been characterized as having a conflict of interest,

given the industry funding of the study and the sole involvement of agriculture schools without inclusion of public health schools ¹¹⁸.

While NAEMS was initiated prior to the Commission report, the EPA made the data from the study available in 2011. The first draft of methodologies for estimating emissions from broiler operations, and manure lagoons and basins at swine and dairy operations, was released for public comment in 2012 ¹¹⁹.

Since the draft data release, the data generated under NAEMS have been subjected to considerable criticism. The Environmental Integrity Project (EIP), an advocacy organization, released a report highlighting instances where the NAEMS data clearly identify short-term instances of exceeding EPA standards for fine and coarse particulate matter, ammonia and hydrogen sulfide, despite serious limitations associated with the methods under which the data were generated and reported. In their report, EIP noted numerous problems with the NAEMS data, ranging from the limited number of facilities monitored, to the problematic placement of monitoring equipment within sites, to the inclusion of negative values for pollutant concentrations in calculated average concentrations for site contaminants ¹²⁰.

EPA's Science Advisory Board has also voiced concerns about the quality of the data and has recommended "that the EPA not apply the current versions of the statistical and modeling tools for estimating emissions beyond the farms in EPA's data set" ¹²¹. Accordingly, there is a possibility that the EPA may not finalize the methodologies. Further, there is an indication that the EPA is holding off on issuing a new rule on the CERCLA/EPCRA exemptions until final emissions estimating methodologies have been developed (personal communication, T. Heinzen).

Chesapeake Bay Total Maximum Daily Load

In December 2010, the EPA established the Chesapeake Bay Total Maximum Daily Load (TMDL) "pollution diet" designed to identify the maximum amount of pollution a body of water can receive and still meet state water quality standards ¹²². The Chesapeake Bay TMDL is the largest such effort to date and was established because of ongoing problems with water quality despite restoration projects. This effort is required under the Clean Water Act and is described by EPA as an integral part of meeting a 2009 Executive Order seeking to restore and protect the Chesapeake Bay watershed ¹²².

The TMDL consists of a set of pollution controls to meet water quality standards in the Bay and tidal rivers. The TMDL calls for sizable reductions in pollutants—including a 25 percent reduction in nitrogen, a 24 percent reduction in phosphorus, and a 20 percent reduction in sediment. Accordingly, IFAP facilities and runoff from

agricultural lands are key targets for limiting pollutants in the watershed. The EPA aims to complete all necessary pollution control methods by 2025, with 60 percent of the actions completed by 2017 ¹²². Should the Chesapeake Bay watershed states and the District of Columbia fail to meet their Watershed Implementation Plans outlining how and when they will meet their pollution allocations, the EPA has stated that it is committed to taking steps including compliance and enforcement actions, expanding requirements to obtain NPDES permits for currently unregulated sources and placing additional controls on pollution sources such as large animal agriculture operations ¹²².

The EPA has also stated that it supports the decision of states to use nutrient trading to help meet their TMDL obligations ¹²³. Currently, Maryland, Pennsylvania, Virginia, and West Virginia have all implemented nutrient trading programs ¹²⁴. Some members of the public health community have recently spoken out against water pollution trading, citing concerns over environmental injustices arising from trading schemes and shortcomings likely to arise from minimized transparency and oversight of trades ¹²⁵. In response to the growing emphasis on this market-based, rather than regulatory, strategy for reducing emissions, advocacy organizations Food and Water Watch and Friends of the Earth filed suit against the EPA to end approval for nutrient trading under the TMDL ¹²⁶. As of August 2013, the case is pending.

State Legislative Efforts

A number of legislative efforts have been made at the state level and aiming at the abilities of states to regulate IFAP sites. Many of these proposed bills were intended to limit or scale back regulatory oversight. In Arizona, legislation was passed that stripped counties of their zoning authority to regulate dairies ¹²⁷. In 2013, Iowa passed legislation weakening the regulation of production site manure management, allowing the reclassification of farm size (and ultimately, the accompanying regulatory oversight/fee structure) on the basis of number of animals present onsite, rather than actual carrying capacity ¹²⁸. In the same year, Iowa also passed legislation to limit public notice requirements for water permits to a notice in a single publication ¹²⁸. Michigan enacted legislation in 2011 that excused animal feeding operations from fines or penalties under the Clean Water Act if they participated in the state's voluntary Agricultural Environmental Assurance Program ¹²⁹. In the same year, Missouri passed a law that put limits on the amount of money awarded in nuisance suits and prohibited repeat filing of nuisance claims regarding the same issues from a single farm ¹³⁰. Ohio passed legislation in 2008 to request from EPA permission to transfer authority over its Clean Water Act program from its environment department to its agriculture department; EPA has since approved the

transfer¹³¹. The same transfer was made by the state of Oregon in 2012, and the legality of that transfer has been questioned by legal researchers¹³².

A small number of state legislative actions appeared to be steps toward more meaningful regulation of animal production sites. In 2009, the Washington State Legislature passed its first law subjecting dairy CAFOs to penalties for failure to comply with recordkeeping requirements for manure management¹³³. The Illinois Legislature passed a law in 2012 requiring CAFOs to pay fees for NPDES permits¹³⁴.

The state of Indiana passed two pieces of legislation that led to mixed impact on regulatory oversight of animal production operations. The first required certification of poultry waste applications (whereas no system had previously existed). In the same bill, local communities were forced to cede control over manure regulations through ordinances to the state^{135, 136}. Indiana also revised its Confined Feeding Operations regulations¹³⁶, but employed setbacks that were criticized by advocacy groups.

State Regulatory Efforts

A number of regulatory policies have been put in place since the release of the Commission report that show signs of promise in regulatory oversight of IFAP sites. In response to a petition from the Illinois Citizens for Clean Air & Water advocacy group, the EPA investigated Illinois' enforcement of the Clean Water Act. In 2010, the agency found merit to the claims that the state was not properly regulating CAFOs, and mandated that it take measures to strengthen its NPDES program and pursue the permitting process¹³⁷. New Mexico set discharge permit regulations for industrial dairies in 2011, including requirements of synthetic liners for dairy waste lagoons and enhancement to public notice provisions for construction of new dairies¹³⁸. Oregon raised water quality permitting fees for CAFOs in 2011¹³⁹.

California is the only state to promulgate regulation that negatively impacted IFAP oversight; it weakened its coverage of operations required to apply for NPDES permits, limiting it only to those already shown to discharge¹⁴⁰.

Agricultural Certainty Programs

A number of states, including Virginia¹⁴¹, Minnesota¹⁴², and Maryland¹⁴³, have now adopted agricultural certainty programs (either through legislation or through current state agency authority). The EPA has also offered its support for states adopting these programs¹⁴⁴. While the provisions of the programs vary by state, the underlying premise is that farmers take voluntary actions that exceed currently mandated practices in return for assurance that they are in compliance with regulations for the duration

of their agreement. Thus, farmers become exempt from any new state requirements that are implemented during that time period. Virginia's recently enacted program, for example, states that participating farmers "would be exempt from any new environmental regulations related to the Chesapeake Bay or local TMDLs or total maximum daily loads" for nine years¹⁴¹. While these programs serve as an incentive for farmers to improve their practices in the short term, exempting farmers from new regulations has also raised concerns among many environmental advocates¹⁴⁵.

Litigation

Issues related to the regulation of IFAP operations have been the subject of a considerable volume of litigation. Highlights from this extensive legal activity are presented here.

Michigan Court Ruling on CAFO Permits

While NPDES permits are now only required for CAFOs that discharge, in 2011 the Michigan Court of Appeals upheld the state's right to also require permits for CAFOs that *propose* to discharge¹⁴⁶. The ruling was based primarily on the fact that the Michigan Department of Environmental Quality (DEQ) administers NPDES permits in the state rather than the EPA, and that the Clean Water Act allows states to implement more stringent requirements than the EPA. Further, the court found that Michigan's Natural Resources and Environmental Protection Act gives the "DEQ authority to forestall potential pollution even before any discharge of pollutants ever occurs"¹⁴⁷. As of May 2013, all CAFOs in Michigan had to obtain either NPDES permits or "No Potential to Discharge Determinations"¹⁴⁸.

Move to Use RCRA in Place of CWA

While most previous legal interventions to address poor practices at individual IFAP facilities have been brought under the Clean Water Act, advocates are now also bringing charges under the Resource Conservation and Recovery Act (RCRA) because of the limitations of the CWA. When used as fertilizer, manure does not qualify as solid waste under RCRA¹⁴⁹. When manure is allowed to discharge into ground water, however, advocates have argued it represents a solid waste regulated under RCRA¹⁵⁰. In April 2013, the Center for Food Safety, CARE, and Public Justice filed suit under RCRA against four dairies in Yakima Valley, Washington¹⁵¹.



Ruling for Perdue in Clean Water Act Case

In 2010, Assateague Coastkeeper and the Waterkeeper Alliance filed a civil suit in the federal District Court of Maryland against a poultry contract grower for Perdue. It was argued that the grower, Hudson Farm, had discharged pollutants in violation of the Clean Water Act. Several water samples from ditches adjacent to the farm revealed high levels of *E. coli*, nitrogen, and phosphorus¹⁵². The Waterkeeper Alliance was represented by the University of Maryland's Environmental Law Clinic. Perdue and state Farm Bureaus characterized the case as an attack on family farms¹⁵³. Maryland Governor Martin O'Malley also wrote a letter to the dean of the UMD Law School to voice concern over the involvement of the Law Clinic, calling their participation "a state-sponsored injustice and a misuse of taxpayer resources"¹⁵⁴. In December 2012, the judge found in favor of Perdue and Hudson Farm, ruling that Waterkeeper failed to prove that the farm's poultry houses were discharging into the Chesapeake Bay¹⁵⁵. The judge also rejected arguments that Perdue, as the integrator, would have been liable for discharges. As of May 2013, Perdue and Hudson Farm had requested over \$3 million in reimbursement for attorney's fees¹⁵⁶.

Other Cases of Note

A number of cases concluded in a manner supportive of regulatory activity. A lawsuit brought by a coalition of environmental advocacy groups against the EPA was settled in a federal court in 2009 that required the EPA to set limits on pollutants associated with animal waste and fertilizer in the state waters of Florida¹⁵⁷. In Nebraska, after an industrial dairy operation challenged two regulations adopted by a local district (the regulations were the basis for denying the facility a permit to install a liquid waste pipeline under a public road), the Nebraska Supreme Court upheld the local district's statutory authority to enact the regulations¹⁵⁸. The regulations in question prohibited liquid waste pipelines from traversing public property, and required minimum setbacks from public use areas, churches, and dwellings. In 2012, a federal court ruled in favor of a Washington state citizens group against an industrial dairy and required extensive pollution monitoring of groundwater, drainage, and land application areas¹⁵⁹.

In some instances, litigation resulted in court decisions that weakened regulatory authority over IFAP sites. In Illinois, an appellate court found that interested citizens and neighboring residents of proposed IFAP facilities do not have standing to challenge Illinois Department of Agriculture construction permitting decisions¹⁶⁰. Following the decision, the Illinois Supreme Court denied review. In 2009, a different appellate court in Illinois overturned a lower court decision in favor of a plaintiff and ruled in favor of an industrial hog operation, requiring the community group that initially brought suit to pay damages related to delay in construction of

the hog production site. The hog producer claimed a loss of \$300,000, but the actual amount to be paid is still in litigation¹⁶¹. A Wisconsin court ruled in 2012 to limit local governments' control of IFAP regulation (via siting or zoning), bolstering authority of the state siting board¹⁶².

Voluntary Industry Efforts

We could not locate evidence of industry measures to enhance regulatory oversight of food animal production sites.

Conclusion

The past five years have seen a number of efforts aimed at weakening federal oversight of food animal production. Some of these efforts, particularly those of regulatory agencies, have been successful in minimizing regulatory authority with regard to air and water pollution. At present, agencies, including the EPA, struggle more with locating food animal production operations than with characterizing and enforcing laws to minimize pollutant releases in order to protect people and the environment. Efforts at the state level have been mixed: In some states, fees and penalties were put in place for IFAP operations that fail to comply with existing regulations. Other states, however, transferred environmental compliance oversight from environment to agriculture departments and attempted to limit state regulatory oversight and enforcement of existing laws. To date, the food animal production industry remains excused from the same scrutiny faced by other industries.

Animal Welfare Recommendations

4. Phase Out Intensive Confinement

Summary and basis for recommendation

Over the past five decades, animal production in the United States has shifted away from an extensive pasture-based system toward the intensive confinement of large numbers of animals of the same species. While this shift has enabled increased production and some economies of scale, it has also resulted in substantially poorer living conditions for animals raised for food. Practices such as confining animals in spaces too small to allow for natural behaviors, altering animals without pain relief, and providing animal feeds that promote growth at the expense of animal health have become routine. Further, there are currently no federal regulations in place to protect farm animal welfare.

In light of these conditions for animals, and the connections between animal welfare, food safety, and the public, the Commission recommended that all intensive confinement systems that restrict the natural movement and normal behaviors of animals, including swine gestation crates, battery cages for laying hens, and tethered veal crates, be phased out within 10 years. The Commission additionally recommended that the force-feeding of fowl to produce foie gras, tail docking of dairy cattle, and forced molting of laying hens by feed removal be ended. Given the capital-intensive nature of these production systems, the Commission also recommended that targeted assistance be made available to help contract producers convert from intensive confinement systems to more sustainable systems.

Recent History Related to the Recommendation

Federal Legislative Efforts

National Egg Standard Legislation

The Humane Society of the United States (HSUS) has pursued actions, either by state legislation, agreements with producers, or voter referendum, to ban the use of intensive confinement systems, especially gestation crates in swine production and battery cages for laying hens. The adoption of Proposition 2 by the voters in California in 2008 eventually led the United Egg Producers (UEP) and HSUS to agree to pursue a national egg production standard.

In 2012, Sen. Dianne Feinstein (D–CA) introduced amendments to the Egg Products Inspection Act to make “enriched colony housing” the national standard for laying hens ¹⁶³. The legislation was based on the agreement between the HSUS and UEP. It would require the adoption of “enriched environments” over a 15- to 18-year transition period. These enriched environments include a doubling of cage size, nesting boxes, and scratching areas,

prohibition of feed or water withdrawal to extend the laying cycle, and prohibition of excessive ammonia levels in henhouses.

The bill would also require transparent labeling of caged and cage-free hens. Additionally, it would prevent states and localities from adopting requirements that exceed those outlined in the legislation regarding minimum floor space and enrichments for egg-laying hens.

The bill was not approved in the 112th Congress and was reintroduced in the 113th Congress. While the bill has a number of industry and animal welfare organization supporters, several groups representing other animal industries, such as the National Pork Producers Council, National Chicken Council, and the National Cattlemen’s Beef Association, oppose it because of concerns that it will open the door for improved standards for livestock and broiler production. An effort by Sen. Debbie Stabenow (D–MI) to add the provisions to the 2013 Farm Bill was abandoned after pressure from beef and pork producers threatened the passage of the overall Farm Bill if it was included ¹⁶⁴. There has also been concern among some animal welfare advocates that the bill’s passage would tie the hands of states seeking to make further improvements (e.g., see <http://stoptherottenegeggbill.org/>). In response to these criticisms, bill proponents point out that the requirements for labeling also included in the amendments would generate higher consumer demand for cage-free eggs ¹⁶⁵.

Proposed Farm Bill Amendment to Overturn Animal Welfare Protections

In 2012, Rep. Steve King (R–IA) successfully added an amendment to the House version of the Farm Bill that would have prevented states from denying the trade of agricultural products from other states that produced the goods in line with federal law and their own state laws ¹⁶⁶.



In short, this would prevent a state from requiring that animal products imported from other states meet the first state's animal welfare standards¹⁶⁷. While the 2012 Farm Bill was not enacted, Rep. King successfully reintroduced the amendment during the 2013 Farm Bill debate in the House. This effort is in response to 2010 legislation passed in California that required all eggs, including those imported from another state, to also meet the animal welfare standards established by California's 2008 Proposition 2¹⁶⁸.

Federal Regulatory Efforts

We could not find evidence of federal regulatory efforts to phase out intensive confinement.

State Legislative Efforts

HSUS-led state ballot initiatives and legislative actions for animal welfare

As previously noted, a number of states have now enacted legislation, passed ballot measures, or negotiated agreements that phase out some of the intensive confinement practices the Pew Commission recommended ending. The HSUS has been instrumental in the adoption of these restrictions.

Since early 2008, the HSUS has successfully led the following efforts at the state level: 1) a bill outlawing gestation crates in Colorado (2008); 2) a ballot initiative phasing out gestation crates, veal crates, and battery cages by 2015 in California (2008); 3) a bill outlawing gestation crates in Maine (2009); 4) a bill outlawing gestation and veal crates in Michigan (2009); 5) a bill outlawing tail docking of cattle in California (2009); 6) a bill outlawing the sale of whole eggs from caged hens in California (2010); and 7) a bill outlawing gestation crates, veal crates, and tail docking in Rhode Island (2012).

Of the above efforts, the 2008 California ballot initiative was the highest profile. Passed with a 63.4 percent majority¹⁶⁹, the initiative bans the confinement of pregnant sows, calves raised for veal, and laying hens "in a manner that does not allow them to turn around freely, lie down, stand up, and fully extend their limbs"¹⁷⁰. The measure also imposes fines and up to six months in jail for violators of the law.

Whistleblower Suppression Legislation

In response to an increasing number of undercover exposé videos and images released by animal welfare organizations documenting cruelty in industrial farm animal operations, a number of states have introduced new legislation to prevent advocates from obtaining footage at agricultural operations. While laws banning unauthorized

filming and photography in animal production facilities were first enacted in the 1990s, whistleblower suppression laws have resurfaced again since the publication of the Pew Commission report. These laws have now become commonly known as "ag-gag" laws by advocates and the media.

Since 2008, a growing number of states have proposed legislation: 1) banning unauthorized filming or photography in agricultural facilities, 2) prohibiting animal advocates from gaining employment at agricultural facilities under false pretenses, and/or 3) stipulating the time frame in which animal abuse evidence must be presented to authorities. These proposed laws have been introduced in states including Arkansas, California, Indiana, Nebraska, New Hampshire, New Mexico, North Carolina, Pennsylvania, Tennessee, Wyoming, and Vermont^{171; 172}. A number of these efforts have failed to pass, been vetoed (most recently in Tennessee¹⁷³), or are still under consideration. However, Iowa¹⁷⁴, Utah¹⁷⁵, and Missouri¹⁷⁵ had all enacted some form of whistleblower suppression legislation by April 2013. The first charges under the Utah law were filed against a woman taking cell phone video footage of a slaughterhouse in February 2013. The charges were subsequently dropped, as she appeared to be on public property while filming¹⁷⁶.

Owing in part to the increasingly negative public opinion of these laws, opposition has also been growing among industry stakeholders. An April 2013 editorial in the industry-oriented publication *Meatingplace* argued against the focus on whistleblower suppression laws and noted that "industry should be taking action long before an activist has the chance to get involved"¹⁷⁷.

State Regulatory Efforts

We could not find evidence of state regulatory efforts to phase out intensive confinement.

Litigation

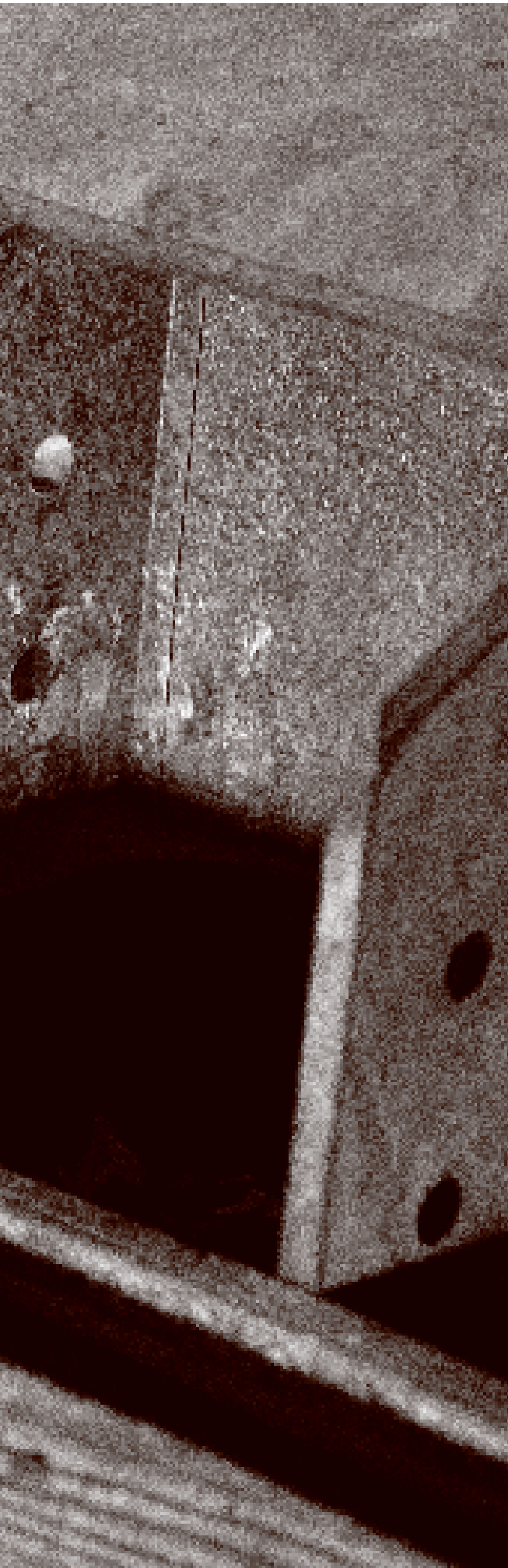
We could not find evidence of litigation efforts to phase out intensive confinement.

Voluntary Industry Efforts

Gestation Crate Agreements with Companies

In addition to working at the state and federal level, HSUS and other animal welfare groups have worked closely with major food companies to phase out the use of gestation crates. A list of some of the major companies that have recently committed to phasing out the use of gestation crates in their supply chains can be found at: www.humanesociety.org/issues/confinement_farm/timelines/timeline_farm_animal_protection.html





Cage-free Egg Agreements with Companies

Many major food companies have also agreed to phase out the purchasing of eggs from producers that use battery cage confinement systems at the urging of HSUS and other animal welfare advocacy groups. A list of some of the major companies that have committed to banning the use of battery cages in their supply chains can be found at: www.humanesociety.org/issues/confinement_farm/timelines/timeline_farm_animal_protection.html

Conclusion and Progress to Date

Efforts to eliminate swine gestation crates, battery cages for laying hens, and tethered veal crates by means of state legislation and through work of the Humane Society of the United States and other groups are very encouraging. Agreements reached between HSUS and a large purchaser of pork and eggs to phase out its acquisition of meat and eggs produced by restrictive confinement systems are encouraging as well. Promises to end purchases of animal products produced in intensive confinement must be monitored to ensure compliance. Promises are easy to make and more difficult to fulfill. A third party verification of company compliance to these agreements would be preferable.

State legislative efforts to criminalize whistleblowers exposing the cruelty of industrial confinement production system must be opposed. The lack of transparency in the industrial food animal production system is a serious concern and presents a concern from a public health perspective.

Rural Community Recommendations

5. Increase Competition in the Livestock Market

Summary and basis for recommendation

As a result of the industrialization of U.S. agriculture over the past 50 years, the economic relationship in agricultural production and rural communities has shifted substantially in favor of the large livestock integrators. The number of companies that exist as potential buyers for producers has declined, narrowing the market opportunities for producers and, therefore, limiting competitive pricing in the sale of animals. No longer independent, many farmers have entered into production contracts with major integrators. These arrangements are generally capital-intensive for farmers, giving them little choice but to continue a contract until their loans are paid off. Furthermore, many farmers find that they must enter into contracts in order to sell their products. As a result of these arrangements, the competitiveness of agricultural markets has been significantly curtailed.

In response to these developments, the Commission recommended strong enforcement of current federal antitrust laws to restore competition in the farm animal market. The Commission also noted that if current antitrust laws are not sufficient to restore competition, then new legislation should be approved to increase transparency in price reporting and limit the ability of integrators to control the supply of animals for slaughter.

Recent History Related to the Recommendations

Federal Legislative Efforts

The 2008 Farm Bill required the secretary of the USDA to help ensure the equity of contracts held by growers and producers. Specifically, the USDA was instructed to identify criteria to determine:

- If an undue or unreasonable contractual preference or advantage has occurred under the Packers and Stockyard Act (“Act”);
- If a live poultry dealer has provided reasonable notice to poultry contract growers of any suspension of the delivery of birds under a poultry growing arrangement;
- When a requirement of additional capital investments over the life of a poultry growing or swine production contract constitutes a violation of the Act;
- If a live poultry dealer or swine integrator has provided a reasonable period of time for a poultry or swine contract grower to remedy a breach of contract that could lead to termination of the poultry growing arrangement or swine production contract; and

- Whether the arbitration process provided in a contract provides a meaningful opportunity for the grower or producer to participate fully in the arbitration process^{178; 179}.

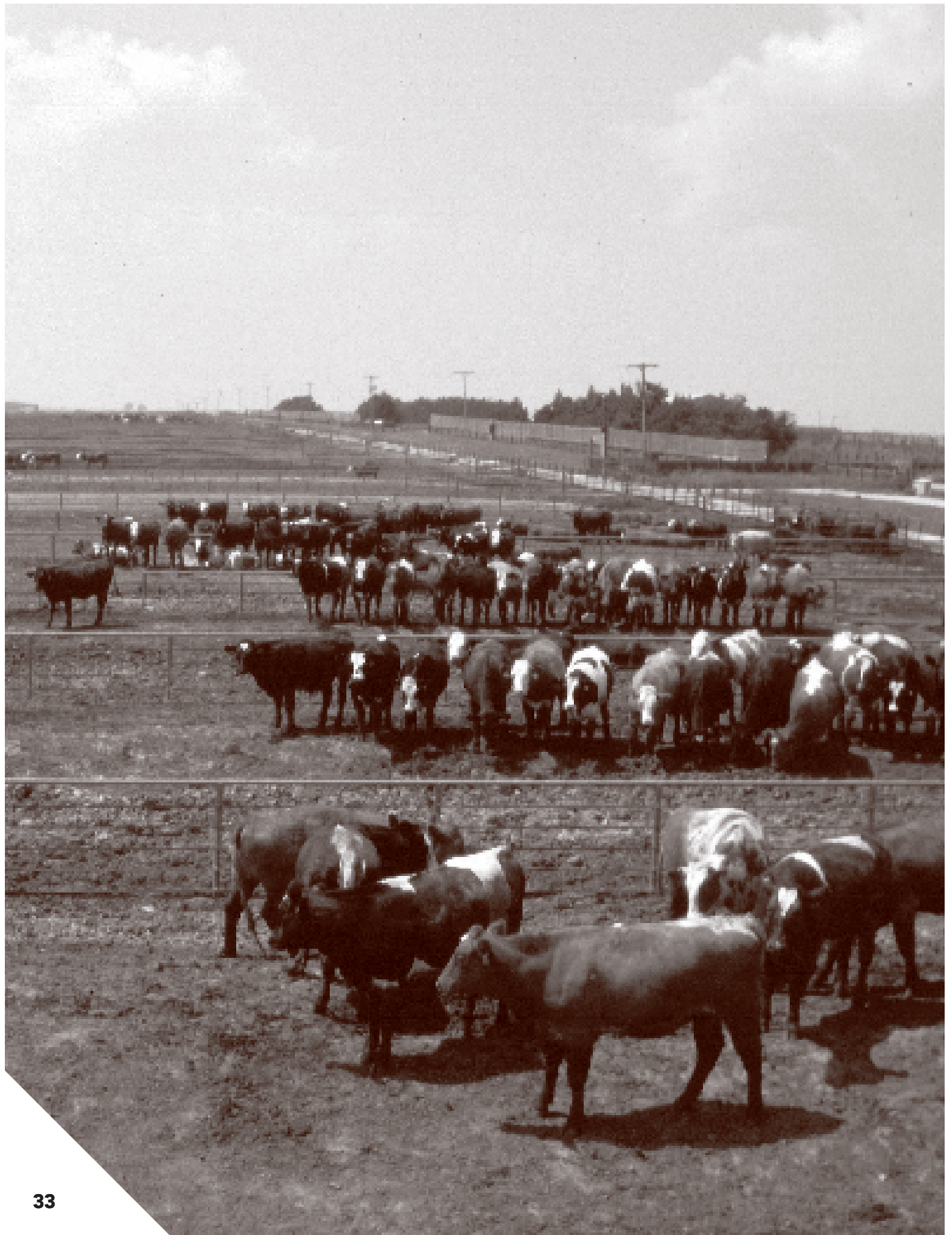
The 2008 Farm Bill also required: 1) that livestock and poultry contracts disclose the right of growers to decline any contractual requirements for arbitration to resolve issues arising under their contract, and 2) that contracts clearly mention any large capital investments that will be required by growers during the term of their contract¹⁷⁹.

Failed Amendment to Ban Packers Controlling Livestock

Senators Chuck Grassley (R-IA) and Tim Johnson (D-SD) introduced Farm Bill amendments in 2012 to ban meatpackers from owning, controlling, or feeding livestock intended for slaughter for more than 14 days before slaughter. Similar provisions were also introduced in 2002 and 2008^{180; 181}. This effort is intended to prevent meatpackers from manipulating livestock markets by slaughtering their own animals when market prices for livestock are high. The provisions would also help increase market access for independent producers¹⁸¹. As of August 9, 2013, no provisions addressing this issue had been enacted.

Failed Livestock Marketing Fairness Act

In both 2009 and 2011, the Livestock Marketing Fairness Act was introduced with bipartisan support. While both efforts failed, the bill would have regulated



the use of forward contracts between meatpackers and producers to help prevent anti-competitive practices¹⁸². A forward contract is an agreement between a producer and meatpacker that locks in a price for an animal before it is delivered for slaughter. Specifically, the provisions would have prohibited forward contracts that do not use a firm base price determined from an external reference source, that are not open for public bid, that are based on a formula price, and that provide for the sale of large numbers of animals¹⁸³. As of August 2013, no provisions addressing this issue had been enacted.

Federal Regulatory Efforts

U.S. Department of Justice (USDOJ) and U.S. Department of Agriculture (USDA) Workshops on Agricultural Competition

In 2010, the Antitrust Division of the U.S. Department of Justice (USDOJ) and the USDA held five joint workshops around the country to explore competition in the agricultural sector. As explained by the USDOJ, the primary intent of the workshops was to “to learn from the real-world experiences of farmers, processors, members of cooperatives, academics, and others who make agriculture their lives’ work”¹⁸⁴. In addition to stakeholders and concerned citizens, attendees included Attorney General Eric Holder, Secretary of Agriculture Tom Vilsack, and representatives of the Antitrust Division of the Department of Justice, as well as several members of the U.S. Senate and House of Representatives, and state and local officials. These workshops addressed a number of topics, including agricultural market concentration, buyer power, and vertical integration of the industry.

In May 2012, the USDOJ released a 24-page final report outlining the common themes of the meetings, the concerns expressed by stakeholders, and how the government can move forward to address the problems facing rural agricultural communities. The dominant theme arising from the workshops was the need for antitrust enforcement to facilitate a healthy and competitive agricultural marketplace. In response to these findings, the Antitrust Division stated that it is “committed to taking all appropriate investigatory and enforcement action against conduct threatening harm to competition in agricultural markets”¹⁸⁵, though the Division also noted that many of the concerns raised at the workshops were beyond the scope of antitrust laws.

GIPSA Final Rule

In June 2010, the Grain Inspection, Packers and Stockyards Administration (GIPSA) proposed an initial rule to carry out the Farm Bill provisions previously outlined. In addition to this language, the initial rule also included a number of discretionary provisions. The provisions included a requirement that dealers disclose

their contracts, prohibitions against retaliatory behavior toward contract growers who speak out against abuses, and a requirement that contracts be long enough to allow growers to recoup 80 percent of investment costs related to required capital investments¹⁸⁶. Not unexpectedly, portions of the proposed rule were controversial, and more than 61,000 public comments were received about it¹⁸⁷.

The final rule, published in December 2011, did not include many of the more controversial initially proposed provisions. Although the USDA stated that it intended to seek additional comments on these provisions, the FY2012 Agriculture Appropriations Bill passed by Congress prohibited the USDA from moving forward on these additional provisions¹⁸⁸.

The final rule included only four key provisions¹⁸⁷:

1. A protection for contract growers by requiring that written notice be given at least 90 days prior to the suspension of a delivery of birds to a grower by a poultry integrator. The integrator must also explain the reason for and length of the suspension, as well as when the delivery of birds is expected to resume.
2. Rules outlining the circumstances under which contract growers can be required to make capital investments.
3. A requirement that contract growers be provided with written notice and an adequate time period to remedy any alleged breaches of contract that could lead to termination.
4. A requirement that any livestock or poultry production contract that required the use of arbitration include language explaining that growers and producers have the right to decline to be bound by arbitration provisions.

The GIPSA rule was further weakened in March 2013 through language included in the FY2013 Continuing Appropriations Act. While continuing to prevent the USDA from taking further action on the additional provisions it had proposed in its initial more comprehensive GIPSA rule, the legislation also rescinded the requirement that poultry contract growers be given at least 90 days’ notice prior to a suspension of a delivery of birds^{189; 190}.

In May 2013, an amendment co-sponsored by Rep. Michael Conaway (R-TX) was successfully added to the House version of the Farm Bill to repeal the 2011 GIPSA rules designed to protect contract growers¹⁹¹. As of September 2013, the Senate and House had passed differing versions of the Farm Bill and will have to go to conference committee.





Final Rule for Interstate Shipment of State-Inspected Meat

In 2011, USDA's Food Safety Inspection Service (FSIS) issued a final rule implementing 2008 Farm Bill provisions allowing state-inspected establishments (in participating states) with 25 or fewer employees to ship meat and poultry products in interstate commerce^{192, 193}. Previously, products had to receive a federal inspection. FSIS staff said the rule will “expand rural development and jobs, increase local tax bases, strengthen rural communities, and ensure that food is safe for consumers.”

State Legislative Efforts

We could not find evidence of state legislative efforts to increase competition in the livestock market.

State Regulatory Efforts

We could not find evidence of state regulatory efforts to increase competition in the livestock market.

Litigation

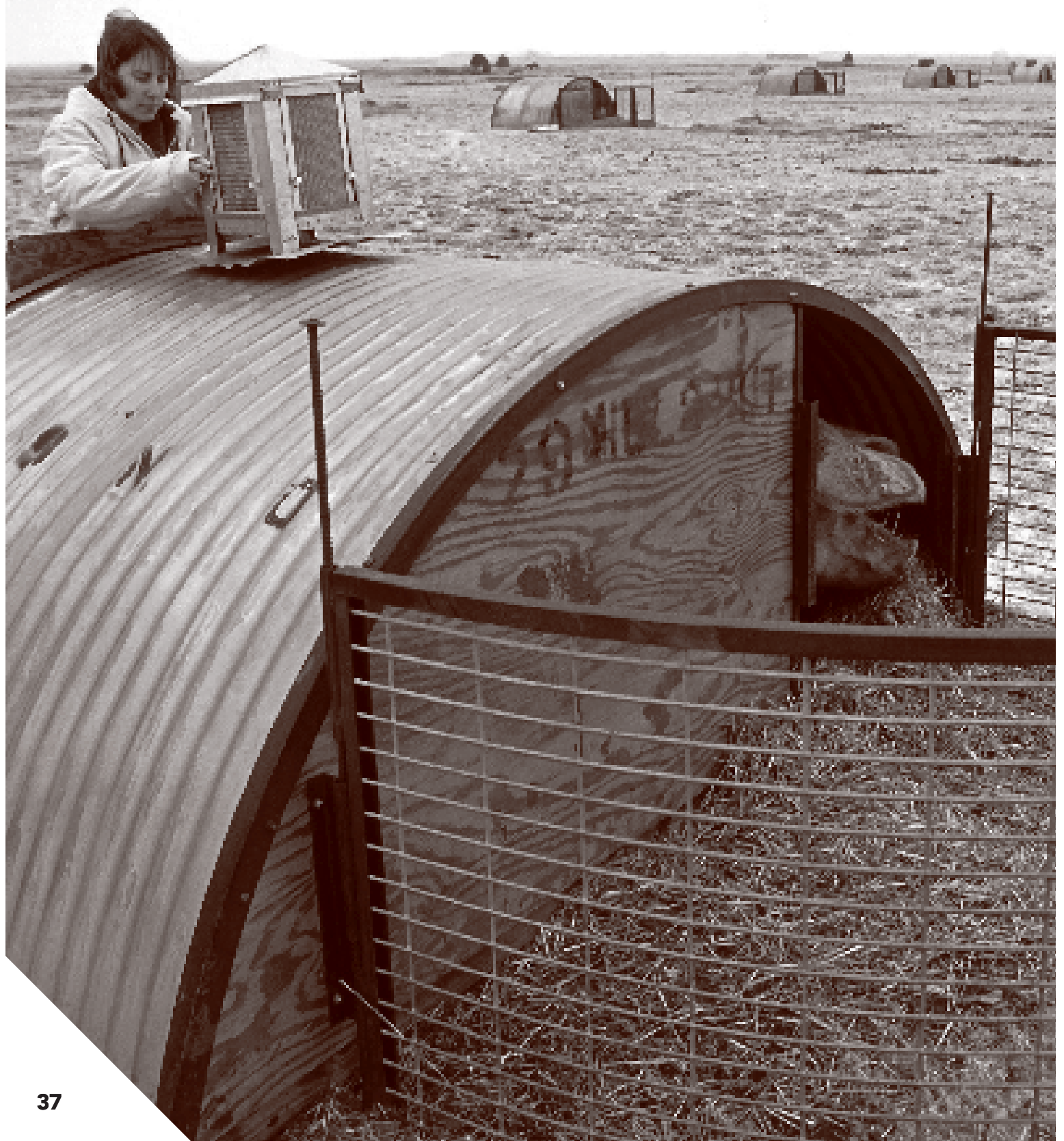
Price Fixing Lawsuits

Since 2008, several lawsuits have been brought against both egg and dairy industries for price fixing. In 2011, Kraft, Kellogg, Nestle, and General Mills filed suit against United Egg Producers and 11 individual egg-producing companies for intentionally inflating prices through the guise of animal welfare reforms in violation of antitrust laws¹⁹⁴. Also in 2011, several dairy consumers filed a class action lawsuit against the National Milk Producers Federation, Dairy Farmers of America, and Land O'Lakes over price fixing¹⁹⁵. Plaintiffs also argued that participants “bought out smaller farmers and instructed them to kill their entire dairy cow herds, unfairly increas[ing] the profits of agribusiness giants”¹⁹⁵. In January 2013, Dairy Farmers of America settled an earlier 2007 class action lawsuit filed by farmers who argued that the National Milk Producers Federation “entered into deals with Dean Foods, which should have been an adversary, creating a monopoly that kept raw milk prices low and gave farmers no alternative buyers”¹⁹⁶.

Voluntary Industry Efforts

JBS/XL Beef Merger Approved by DOJ

In October 2012, Brazilian-owned food processing company JBS announced its intention to acquire two XL Four Star Beef Plants in the United States¹⁹⁷. Many agricultural groups opposed the deal because of concerns that it would reduce competition and be detrimental to



U.S. cattle producers. The merger would reportedly result in JBS becoming the largest “beefpacker in the United States and in the world”¹⁹⁸. Groups also called on the Department of Justice (DOJ) to conduct a thorough review of the merger¹⁹⁹. In March 2013, the DOJ ended its investigation without taking any action, thus allowing the merger to take place¹⁹⁸.

Chinese Purchase of Smithfield

In May 2013, the Hong Kong-based Shuanghui International Holdings offered to buy Smithfield Foods of Smithfield, Virginia, for \$4.7 billion. Smithfield, founded in 1936, is the world largest pork producer, employing more than 45,000 people in 25 states. This proposed sale has raised concerns from members of the House and Senate, as well as many producers and consumers.

The Senate Agriculture Committee has conducted oversight hearings on the proposed sale. Senators expressed concerns about the impact this sale would have on U.S. producers and consumers. The Committee on Foreign Investment in the United States (CFIUS), a division of the U.S. Department of the Treasury, approved the proposed sale on September 6, 2013. The CFIUS process begins when the parties involved notify it of the proposed sale. “CFIUS members examine the transaction in order to identify and address, as appropriate, any national security concerns that arise as a result of the transaction”²⁰⁰.

Smithfield shareholders approved the sale on September 24, 2013, clearing the final hurdle for the sale to move forward.

Conclusion

The consolidation in the meat industry has continued unabated worldwide. JBS, the largest meat processor in the world, has purchased U.S. companies Swift and Company and XL Beef Processing. In addition, it is the majority owner of poultry giant Pilgrim’s Pride Corporation. All three major brands have several smaller marketing brands. With the proposed sale of Smithfield to Shuanghui International Holdings, the number of processing options for producers will decrease even further.

The nearly total, vertical integration of the poultry industry is a cautionary tale for the remaining sectors of animal protein production. Virtually all poultry production is under contract production, which restricts the independence of producers, tying them to the integrator with few rights. The swine industry is now moving in the same direction, with more integrator control and loss of producer independence.

The initial regulatory efforts by USDA and DOJ in 2009 and 2010 were hopeful signs. New contracting rules for poultry producers initially issued by USDA’s GIPSA were encouraging. The near-total collapse of those efforts, with subsequent erosion of producer contracting rights promoted heavily by integrators in legislation approved by the House and Senate, will allow continuing harm to producers and the economic deterioration of rural communities.

The aggressive enforcement of the antitrust laws in the United States, a primary recommendation of the Pew Commission, is needed now more than when the original report was issued in 2008.

Research Recommendations

6. Improve Research in Animal Agriculture

Summary and basis for recommendation

When the Commission was preparing its report prior to its release in 2008, a recurring theme identified in its deliberations was the inadequate level of public funding for research into public health issues related to the industrial production of food animals.

Recommendation—Specific Approach

To assess any changes in relevant research funding, data on public- and private-sector research investments in food animal production and human health were sought and evaluated.

Public and private expenditures for research and development

Fuglie and colleagues quantified U.S. private-sector investments for research and development in food and agriculture ²⁰¹. Estimates for funding from 2000 through 2011 were tallied (Figure 1). In addition, Fuglie and colleagues provided estimates of private-sector expenditures for research and development directly related to food animal production (the sum of expenditures for animal health, animal nutrition, and animal breeding research and development). These amounts are also depicted in Figure 1.

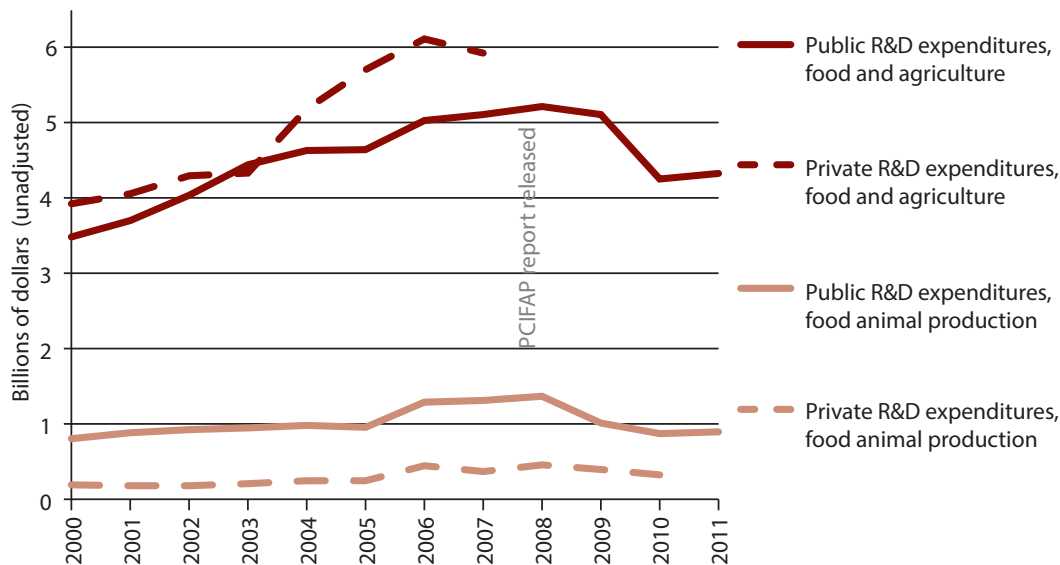
Private-sector expenditures were compared with those of the U.S. Department of Agriculture (USDA), State

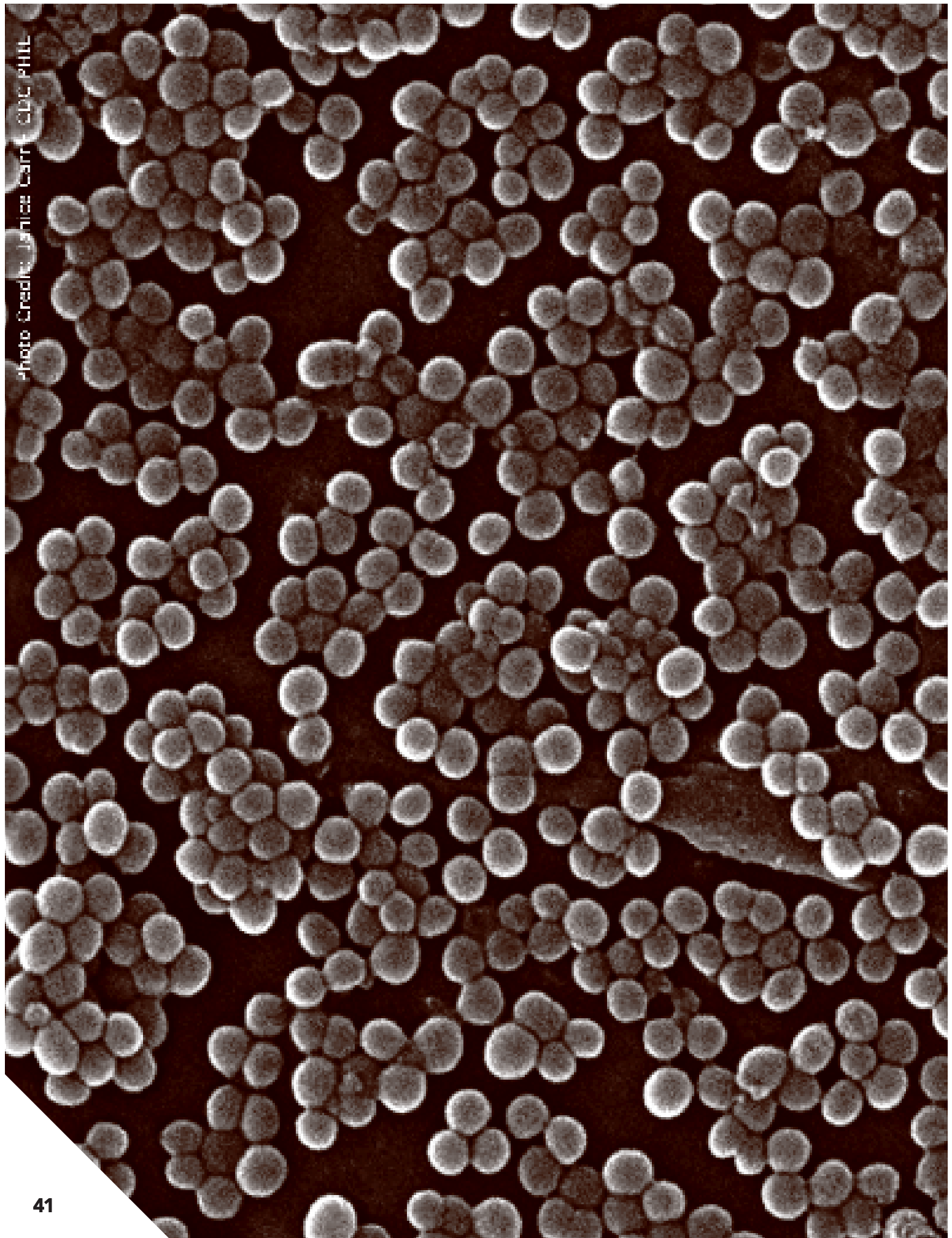
Agricultural Experiment Stations (SAES), and other federal and state institutions. These amounts are derived from the Current Research Information System (CRIS) database ²⁰², available online through the USDA National Institute of Food and Agriculture.

The research projects listed in CRIS are conducted or sponsored by federal and state institutions, land-grant universities, and participants in federally administered grant programs. The data in CRIS are based on reports by the institutions making the research expenditures, not by the funding institutions. As a result, some industry-funded research is recorded in CRIS, but research performed by the private sector is not ²⁰³. Based on data from 1998, the majority of SAES research and all of USDA research was publicly funded (Fuglie 2011), suggesting that CRIS data are largely representative of public—not private—research funding.

CRIS data on public expenditures for research and development in food and agriculture were summed from 2000 through 2011 (Figure 1). In addition, to estimate expenditures for research and development related to food

Figure 1: U.S. Public and Private Sector Research Expenditures for Food and Agriculture, and for Food Animal Production.





animal production, R&D expenditures for feed and feed additives, general animal research, and poultry, swine, ruminant, and aquatic animal production were also tallied. The total expenditures for these research areas, by year, are also depicted in Figure 1.

Public expenditures for food and agricultural research and development peaked in 2008 at \$5.2 billion, before declining to \$4.27 billion in 2010. Public expenditures for research and development related to food animal production also saw a decline in 2008. Private research investments in food and agriculture have largely matched public investments from as early as 1975²⁰¹.

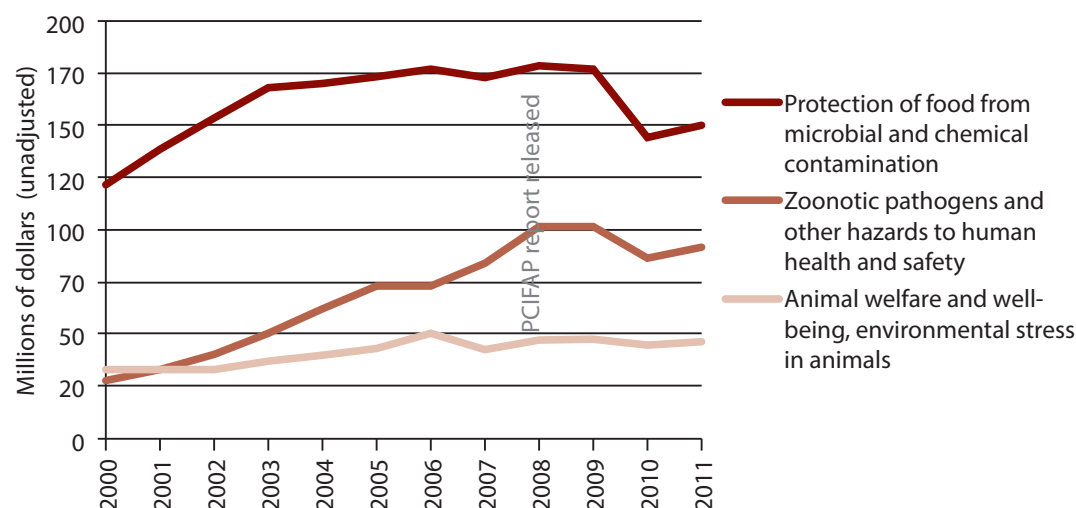
health and safety; animal welfare; and environmental stress in animals) were also examined. The R&D expenditures for each of these research areas from the 2000–2011 fiscal years are presented in Figure 2.

Public research funding for zoonotic pathogens and other hazards to human health and safety peaked at \$102 million in 2008; research expenditures for protecting the food supply from microbial and chemical contamination peaked at \$178 million, also in 2008; and research dollars for animal welfare and stress peaked at \$50 million in 2006. Despite modest increases in 2011, public expenditures for research on these and other areas of importance to public health remain low.

Public research investments in selected priority areas

Additional research areas with the CRIS database that are of particular relevance to issues discussed in the PEW report on IFAP (microbial and chemical contamination of food, zoonotic pathogens, and other hazards to human

Figure 2: U.S. Public Research and Development Expenditures for Selected Priority Areas



National Institutes of Health Research Funding

To further characterize public funding for research related to food animal production and human health, project funding awarded by the National Institutes of Health (NIH) from 2000 through 2012 was analyzed. Using the *RePORT* online search tool available through the NIH ²⁰⁴, the search terms listed in Table 1 (below) were applied to identify relevant projects. This generated a list of 151 project-years (e.g., the same project funded for three years counts as three project-years). Search results were manually reviewed, in order to select only those projects that were pertinent to food animal production and human health.

The final list of relevant NIH-funded research projects represented 111 project-years and included studies related to zoonotic diseases (e.g., avian influenza, bovine spongiform encephalopathy, *E. coli*, antibiotic-resistant strains of *Staphylococcus aureus*), injuries and other occupational health harms, airborne hazards arising from production sites, and risks associated with chemical hazards in food (e.g., hormones implanted in beef cattle). NIH funding for these projects, by year, is depicted in Figure 3. The relative amounts of funding provided by each institute are depicted in Figure 4. The National Institute for Occupational Safety and Health (NIOSH) provided the largest share (62 percent) of funding for the selected research projects, followed by the National Cancer Institute (NCI, 11 percent) and the National Institute of Allergy and Infectious Diseases (NIAID, 9 percent).

The growth in NIH-funded research at the intersection of food animal production and human health from 2000 (\$0.2 million) to 2008 (\$5.9 million) suggests a growing awareness and appreciation of these issues among the scientific community. A drop in funding in 2009 may be

attributable to budget cuts following the 2008 financial crisis. Continual growth in public research funding for these areas remains a prominent public health priority.

Conclusions

Public research investments in topics related to IFAP and public health, and food animal production in general, declined following the issuance of the Commission's recommendations in 2008. Much of this decline may be attributable to budget cuts following the financial crisis of 2008. Since 2010, public expenditures in food animal production, and food and agriculture in general, have returned to an upward trend but still remain below 2008 levels. The levels of NIH funding described in this document, which may be the most pertinent to the issues described in the Commission's report, saw a dramatic rise from 2000 (\$0.2 million) to 2008 (\$5.9 million), suggesting a growing awareness and appreciation of IFAP issues among the scientific community. Levels of NIH funding for these issues, however, have since remained unsteady. Increased public funding for these research areas remains a public health priority.

Table 1: Search terms applied to the NIH project database

"food animal production"	"broiler poultry"	"hog farm"	"dairy farm"
"animal agriculture"	"poultry operation"	"hog operation"	"dairy cattle"
"animal feed"	"poultry processing"	"swine farm"	"dairy production"
"animal feeding operation"	"poultry industry"	"swine operation"	"dairy processing"
"meat production"	"laying hen"	"pork production"	"dairy industry"
"meatpacking"	"egg industry"	"pork processing"	"beef cattle"
"meat packing"		"swine industry"	"beef production"
"meat processing"		"pork industry"	"beef processing"
"meat industry"			"beef industry"
"animal waste"			feedlot
cafo			

Figure 3: NIH project funding for research related to food animal production and human health, by year, 2000-2012.

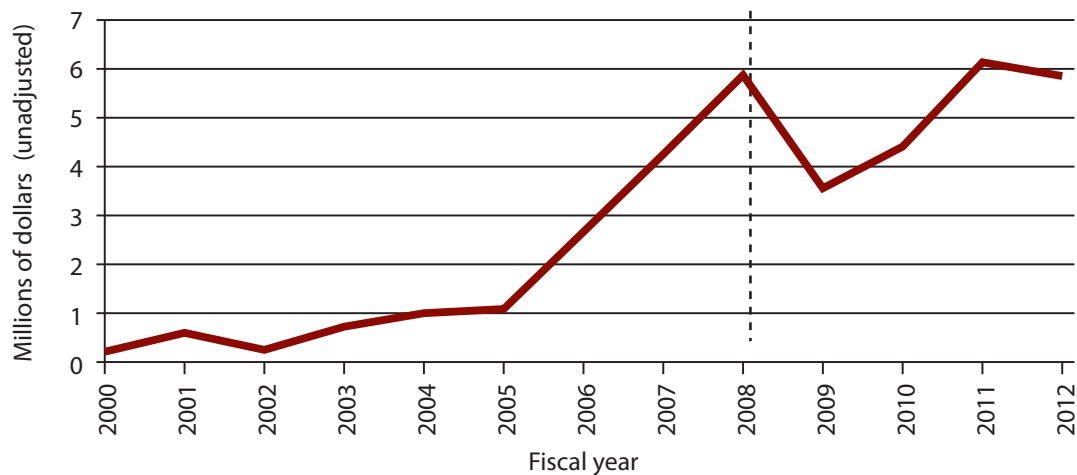
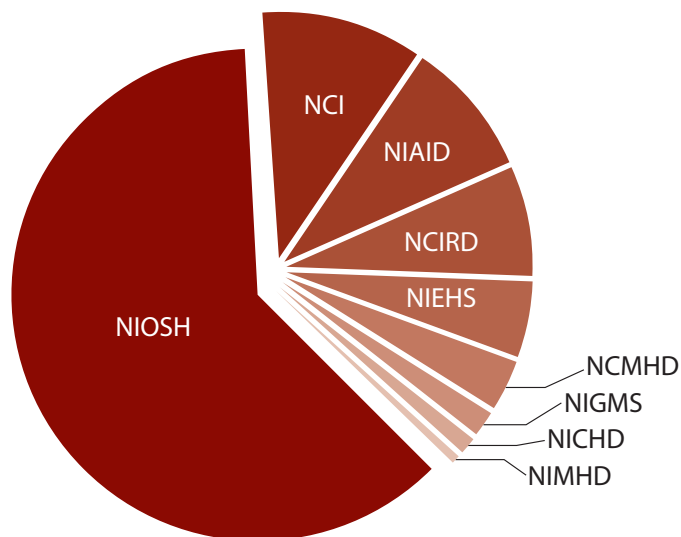


Figure 4: NIH project funding for research related to food animal production and human health, by institute, 2000-2012.



Conclusion

Five years ago, the Pew Commission on Industrial Farm Animal Production released its landmark report, *Putting Meat on the Table: Industrial Farm Animal Production in America*. The report was a critical first step in documenting the unsustainable nature of the dominant contemporary model of food animal production. The risks posed by that model to people, to the welfare of animals, and to environmental quality, as well as to the ability of the planet to sustain future life, were clearly described in the report and in its technical appendices.

Many hoped the release of the report, which occurred within a year of a change in the administration, would help trigger a sea change in the federal government's approach to regulating the food animal production industry. Advocates were confident that the incoming Obama administration would offer a substantively different philosophy with respect to the impact of the food animal production industry on human health and the environment as compared to the policies and actions of the Bush and preceding administrations. Early administrative appointments to top regulatory posts held promise for meaningful changes.

CLF's review of the policy-landscape changes in the five years since the release of the report paints a very different picture. Contrary to expectations, the Obama administration has not engaged on the recommendations outlined in the report in a meaningful way; in fact, regulatory agencies in the administration have acted regressively in their decision-making and policy-setting procedures. In addition, the House of Representatives has stepped up the intensity of its attacks on avenues for reform and stricter enforcement of existing regulations, paving the way for industry avoidance of scrutiny and even deregulation, masked as protection of the inappropriately termed "family farmer."

The assaults on reform have not been limited to blocking policies that would hold IFAP operations accountable for hazardous environmental pollution and other practices that endanger the public's health. Instead, the policy debate over IFAP has shifted to the implementation of policies such as "ag-gag," agricultural certainty, and right-to-farm laws, all of which are designed to further shield unsavory industry practices from the eye of the public and the intervention of regulators.

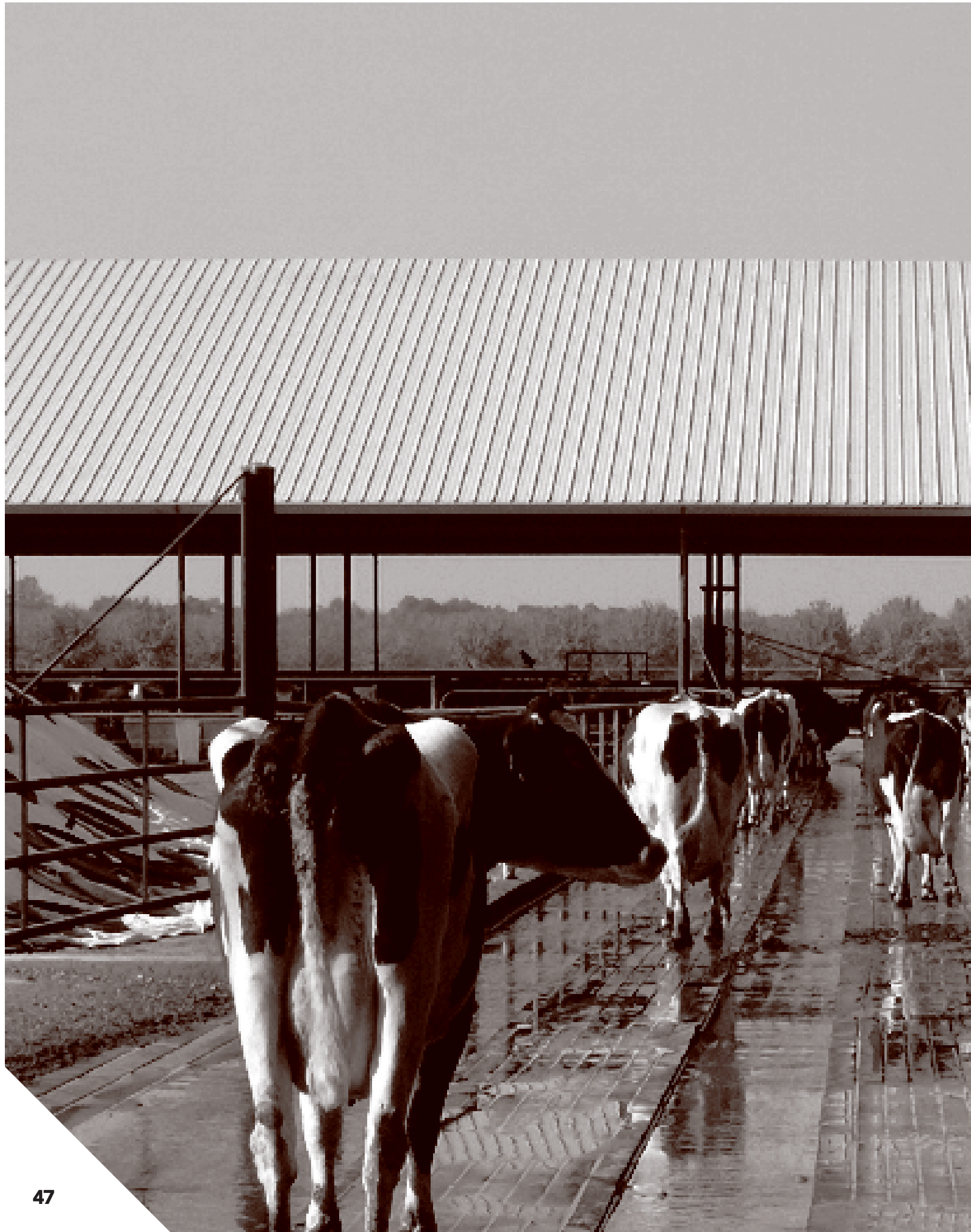
Unfortunately, economic changes within the industry warn of stormier seas ahead. With increasing concentration in the meat and dairy industries, the health of competition is looking dire. In addition, with the evolving international control and greater concentration of domestic meat production industries, we are moving further away from any notion of regionalized food systems

that capitalize on the production of geographically and culturally appropriate food commodities. Instead, in an era of a rapidly expanding body of literature linking a high-meat diet to increased risks of serious morbidity and premature mortality, we are continuing on the current trajectory—one designed to externalize costs to the greatest possible degree while slashing the retail prices of animal products.

These actions, however, have not gone unnoticed by the American public. Frequent reference is made to the notion that the United States is experiencing a "food revolution." The abuses of the current food system are increasingly becoming part of the societal lexicon. Recent events such as AFA Foods' bankruptcy filing related to public reactions to learning about lean, finely textured beef ("pink slime")²⁰⁵ illustrate how public awareness can have a powerful market influence. It has become increasingly clear that the public, when informed, can be an ally for change.

Public engagement has been a tool employed by advocacy organizations in support of change, with some successes in recent years. State-level organizing by nongovernmental organizations on a variety of issues, ranging from animal welfare abuses to arsenicals in animal production, has resulted in policy changes that seem promising, at least at the outset. Although progress on the policy front is often weakened by stipulations or amendments (e.g., the exemption of nitarsone from the Maryland arsenic ban), even minor victories can be seen as a sign that greater successes in the form of more rational changes are more likely.

While many efforts to engage the industry in making changes are met with failure, the past five years have demonstrated in a small number of cases (especially in the animal welfare arena) that pressure from advocacy groups, especially in the form of state-level grassroots campaigns, can spur advocacy-industry partnerships to address specific systemic ills. Examples of this are the proposed ban on battery cages and statewide bans on gestation crates in the egg layer and swine industries, respectively. These changes are incremental, and seen as inadequate by





many, but they do signal a slow and reluctant move away from the most egregious production practices. Of course, history has shown that voluntary commitments to change from industry are typically unmonitored, and the lack of industry transparency masks reversals of promises of more sustainable practices.

If the health, animal welfare, and ecological externalities associated with the industrial model of food animal production are to be minimized or eliminated, the past five years have made clear what needs to happen to bring about true reform. First, an engaged and informed public is a necessary cornerstone of any effort to facilitate meaningful change; this need is highlighted by recent industry attempts to eliminate transparency and limit public access to information about standard industry practices. Second, it is essential to have a legislative body that prioritizes the interests of the public over those of corporate entities. As seen in numerous settings, our current Congress has struggled with the public/private balance and has made decisions in favor of the latter. Third, we need an administration that empowers its agencies to satisfy their existing mandates, including both effective rulemaking and competent enforcement of existing and new regulations. Without a coordinated strategy that brings together these pieces, it is unlikely we will see real change in the near future.

Introduction to Afterword

As part of the original report, Commission member Dr. Fred Kirschenmann was asked to draft a statement on behalf of the full Commission on what a sustainable animal agriculture production system would be. His statement was adopted as a conclusion to the original report and was titled, “Toward Sustainable Animal Agriculture.”

In assessing the impact of, and continuing need for, the original Commission recommendations, Dr. Kirschenmann was asked again to comment on the changes that have occurred in industrial animal agriculture since the release of the original report and the challenges presented by the economic, climate, and population change in the past five years. The afterword, “Designing a Resilient Agriculture in a Changing World,” is reprinted with permission of the author.

Afterword

Designing a Resilient Agriculture for a Changing World
by Frederick Kirschenmann

“The world at the close of the 20th century is a fundamentally different world from the one in which the current scientific enterprise was developed.”

—Jane Lubchenco, 1998 ¹

As Jane Lubchenco pointed out in her presidential address to the annual meeting of the American Association for the Advancement of Science on February 15, 1997, we are on the cusp of entering into a very different world from the one we have lived in for the past century. And while most of us, including the scientific community, have been reluctant to anticipate these changes, they are now rapidly imposing themselves upon us, and our food and agriculture systems will be among the first to be affected. Among the many challenges that our new “contract” will need to recognize, as Lubchenco pointed out, is “the extent of human domination of the planet.”

Lubchenco made these observations based on an awareness of the “problems of the coming century.” At least half of the “problems” that Lubchenco outlined are directly related to agriculture. Among those many problems is the fact that “more atmospheric nitrogen is fixed by humanity than by all natural terrestrial sources combined.”

Any farmer interested in farming successfully, and any government interested in a secure food system for the decades ahead, must anticipate these impending changes and begin designing an agriculture that can adapt to them.

This redesign will need to be differential—a paradigm shift! Simply modifying or intensifying the current system will not meet the challenges ahead. In the “adaptive cycle” language proposed by the Resilience Thinkers, we are entering the “reorganization” phase, which is characterized by “uncertainty, novelty and experimentation” ².

In fact Ernest Schusky suggests that we are about to enter a new “era” of food production that will, of necessity, be significantly different from the food system we designed in the early 20th century. This will, in fact, be another “cultural” shift, which “consists of everything that humans have, do, or think.” It will of necessity be a shift similar to our transition from the hunter-gatherer era to the Neolithic Revolution, and the shift from the Neolithic (agrarian agriculture) Era to what Schusky calls the “neocaloric” era. The “Neocaloric Era,” which evolved in the early 20th century (and was adopted on a large scale

after World War II), was made possible by fossil energy, which not only changed agriculture, but our “whole way of life.” The “Neocaloric Revolution has converted rural societies into urban societies and altered international relations while bringing pollution and erosion to such heights that life itself is now threatened” ³.

Schusky argues that the Neocaloric Era will of necessity be a VERY short period in the timeline of human history because it is entirely sustained by “old calories.” We are rapidly using up those calories, and once they are gone, that way of producing our food will no longer be possible. These “old calories” consist of fossil fuels, fossil water, rock phosphate, potash and other critical minerals ⁴. Once these old calories are gone (some argue in another hundred years, but realistically in much less time given the rate at which we are depleting them) we will no longer be able to sustain an agriculture system that is totally dependent on them. Of course, long before these old calories are gone, they will become prohibitively expensive. In fact, increasing costs are already affecting our food and farming system, and would likely already render it dysfunctional were it not for various subsidies. Consequently, the Neocaloric Era is, essentially, already over!

Of course, as Schusky points out, it is not just the loss of the old calories, but also the social and ecological damage that this industrial economy has caused, that now renders it unsustainable. In fact the resultant damage is so extensive that it now “threatens life itself” and therefore necessitates the transition to a new “post-neocaloric” era. Included in this resulting ecological and social damage

is soil loss and soil degradation, loss of biodiversity and genetic diversity, loss of freshwater, devastating climate change (which ensures more unstable climates), the loss of human capital (farmers), and the loss of community services, as well as the loss of a sustaining community culture.

As Marjory Kelly has pointed out, we have now created a culture that fosters an “extractive” economy (which motivates individuals to extract as much wealth as possible for themselves out of their communities), rather than a “generative” economy (which motivates people to work toward the common “flourishing of life” within their communities) ⁵.

It is the “loss” of all of these resources—old calories, self-renewing ecologies, flourishing communities—that were used up or destroyed by the industrial economy of the past century, that now requires the design of a new economy, and a new agriculture. Since food and water are the essentials of life, designing the new agriculture is the most urgent task before us in this new, post-neocaloric era!

So, how shall we now proceed?

First, I think it is important to recognize that, as a species, we humans do not have a compelling record demonstrating a capacity to predict the future or to foster the changes necessary to create a new future. We do, however, have a record of some civilizations that were able to anticipate the changes coming at them and getting a head start preparing for them. In fact, based on his extensive research of past civilizations, Jared Diamond concluded that the reason some civilizations in the past thrived while others collapsed was due to that capacity. Those civilizations that anticipated the changes coming at them and got a head start preparing for them tended to thrive, while those that failed in that exercise tended to collapse ⁶.

Consequently we would probably be wise to use less of our potency trying to get farmers and other entrepreneurs in the food industry to change, and more in helping them to anticipate the changes coming at them and how they might prepare for those changes.

So let’s imagine that 10 or 20 years from now crude oil will be \$300 per barrel, that we have twice the number of severe weather events, half the amount of freshwater available, and fertilizers that cost five times what they cost today. What kind of agriculture could we put on the landscape that would be “sustainable?”

Clearly, it would not be the high-input, specialized monocultures that served us so well during the Neocaloric Era! It would more likely be an agriculture that is more ecologically sound—more diverse, redundant, self-renewing and self-regulating—an agriculture, in short, that mimics nature ⁷.

Fortunately, if this is the most effective way to prepare for the changes coming at us, we have a lot of resources available to us. First, there is the wisdom of the past.

We know there were many agriculturalists who were reluctant to adopt industrial agriculture when it first emerged in the early 20th century. Sir Albert Howard, Rudolf Steiner, Lady Eve Balfour, Aldo Leopold, and many others perceived the inherent deficiencies of industrial agriculture and urged an alternative that was more consistent with nature’s prototype. Sir Albert Howard, in fact, referred to the “N,P,K mentality” (as he called the industrial system) as a form of “banditry” since he saw that it would deplete the biological health of the soil, which he knew would steal the inherent capacities of the soil from future generations.

So we have this wisdom from the past that we can now marry with the science of ecology and evolutionary biology to design a new agriculture for the future, an agriculture that would be much more self-renewing and self-regulating, and therefore less dependent on the old calories of the Neocaloric Era. Some now refer to this new, emerging agriculture as a “new agrarianism.”

There is, in fact, a new generation of farmers and researchers who are already anticipating the changes coming at us and exploring alternatives. The February 2013 issue of the John Deere “The Furrow” magazine, for example, was entirely devoted to stories about farmers and soil scientists who are “building better soils.” These farmers are discovering that by adopting alternative management strategies, like incorporating cover crop mixtures into their corn/soybean rotations, they can reduce fertilizer and pesticide inputs by more than 70 percent and still sustain high yields. A farmer near Bismarck, North Dakota, reported that before he introduced these new management practices his soils could only absorb “a half-inch of water per hour. Now they’ll take in eight inches.” Clearly he sees this as one way to anticipate and prepare for a future with more droughts and floods ⁸.

A team of soil scientists working with NRCS are discovering similar results working with farmers and incorporating cover crop mixtures into cropping systems (National Soil Health and Sustainability Team, Greensboro, NC).

Matt Liebman, weed ecologist at Iowa State University, has conducted nine years of research comparing conventional corn-soybean rotations with rotations that added a year of small grains, red clover and/or alfalfa. Compared to the conventional two-crop monocultures, the more diverse rotations greatly reduced the need for fossil fuels, chemicals and synthetic fertilizers, and maintained comparable yields and profitability. Liebman and others have also conducted research that demonstrates potential production and ecosystem benefits from other examples of incorporating diversity into production systems in the Midwest ⁹⁻¹¹.

There are also numerous permaculture farming operations, like Takao Furuno's in southern Japan ¹² and agro-forestry enterprises that show similar ecological and economic benefits. All of these alternatives are based in diversity, soil health, and biological synergies that reduce energy inputs, reduce pest pressure, and increase food production ¹³.

The United Nations has also published four reports in the past five years (*Agriculture at a Crossroads, Save and Grow, Toward the Future We Want, and Agro-ecology and the Right to Food*), and while each of these reports features some unique ideas, a common theme is evident. While new technologies and increased yields may play a role in solving the problem of hunger, the central issues that must be addressed are the empowerment of local, small-holder farmers practicing agroecological methods, food accessibility for all, investment in agricultural knowledge adapted to local ecologies, multi-stakeholder participation, and the empowerment of women.

Perhaps the most important example of anticipating the changes coming at us and getting a head start preparing for them is taking place in Salina, Kansas. Thirty years of research at the Land Institute is producing another option that will become available to farmers in the not-too-distant future—perennial crops! Perennial crops will save significant energy inputs. Crops only need to be planted once every five or six years instead of every year, deeper root systems help to restore the biological health of the soil, enable plants to access moisture from deeper in the soil profile, and sequester significant quantities of carbon. The combination of those benefits will go a long way toward addressing most of the challenges coming at us in the post-Neocaloric Era.

These are all encouraging innovations that can serve us well in anticipating the changes coming at us and getting a head start in preparing for them. However, as Schusky and Lubchenco have both pointed out, we also have a “cultural” problem that must be addressed. The Enlightenment culture of individualism fostered the notion that humans were somehow separate from nature and that humans could (in fact “must”) dominate the planet. That sense of domination, together with the industrial economy which taught us that maximum, efficient production for short-term economic return was an essential economic paradigm that every farmer and food entrepreneur presumably must incorporate into their businesses to be economically successful. Consequently, that paradigm became deeply entrenched in our economic culture.

However, as we have learned from the science of ecology, we are not separate from the rest of nature, and nature is not a collection of objects that we can dominate, but a dynamic community of interdependent subjects of which we are an intimate part. Consequently, we are not the “conquerors” of the land community; we are simply “plain members and citizens” as Aldo Leopold reminded us. Leopold was, of course, deeply troubled by the dilemma of

the conflict between sound ecological stewardship of the land community and the economic pressure to use land as a commodity to achieve maximum economic returns.

Leopold finally concluded that the only way to overcome this predicament was to cultivate an “ecological conscience” that “in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity” ¹⁴.

Of course, Leopold had no magic-bullet solution for developing such a “conscience,” and so the need to cultivate this deeper understanding of the human/nature relationship continues to be part of our mission as we anticipate the changes coming at us. In this regard it is inspiring to see an increasing number of a new generation of young people who seem to have overcome their “nature deficit disorder” and are now determined to “leave no child inside” ¹⁵. This new generation is reconnecting to nature, to soil, and to farming and increasingly they are choosing careers in farming.

In addition, another cultural transformation is underway among food customers. This transformation is gradually turning passive recipients of food into active food citizens, a phenomenon that is now fostering the emergence of “food hubs.” These “hubs” consist of food citizens who in their own “food sheds” are determined to develop regional food systems in which the majority of the food is produced by people in the hub, for people in the hub, and exports and imports become the second priority. This phenomenon is gradually developing a new food culture that consists of a diversity of people, including farmers, bankers, educators, food entrepreneurs, Cooperative Extension personnel, and ordinary citizens, all devoted to creating a new food network that provides regional communities with healthy, affordable, nutritious food for all in the community. These new food hubs have the potential to significantly reduce energy inputs, restore ecological and human health as well as the pleasure of good eating, all of which can serve to enhance the flourishing of life.

Together, these various innovations can be the beginnings of the potential to create the new food system that will be essential in our new world.

Of course, the big elephant in the room is climate change. We need to scale up all of these ecologically sound systems before “biospheric entropy” changes our world in ways that question the survival of the human species ¹⁶.

References

1. Pew Charitable Trusts (2013). About Us. Retrieved August 8, 2013, from http://www.pewtrusts.org/about_us.aspx
2. Pew Commission on Industrial Farm Animal Production (2008). *Putting Meat on the Table: Industrial Farm Animal Production in America*. Baltimore, Maryland: Johns Hopkins Bloomberg School of Public Health. Available at http://www.ncifap.org/_images/PCIFAPFin.pdf
3. Silbergeld EK, Graham J, Price LB (2008). Industrial food animal production, antimicrobial resistance, and human health. *Annu Rev Public Health*, 29, 151-169.
4. Smith DL, Harris AD, Johnson JA, Silbergeld EK, et al. (2002). Animal antibiotic use has an early but important impact on the emergence of antibiotic resistance in human commensal bacteria. *Proc Natl Acad Sci USA*, 99(9), 6434-6439.
5. U.S. Food and Drug Administration (2011). *Summary Report on Antimicrobials Sold or Distributed for Use in Food-Producing Animals*. Available at <http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM338170.pdf>
6. Slaughter L (2013). PAMTA. Retrieved September 6, 2013, from http://www.louise.house.gov/index.php?option=com_content&id=1315&Itemid=138
7. Love DC, Davis MF, Bassett A, Gunther A, et al. (2011). Dose imprecision and resistance: Free-choice medicated feeds in industrial food animal production in the United States. *Environ Health Perspect*, 119(3), 279-283.
8. Love DC, Halden RU, Davis MF, Nachman KE (2012). Feather meal: A previously unrecognized route for reentry into the food supply of multiple pharmaceuticals and personal care products (PPCPs). *Environ Sci Technol*, 46(7), 3795-3802.
9. Sapkota A, Ojo K, Roberts M, Schwab K (2006). Antibiotic resistance genes in multidrug-resistant *Enterococcus* spp. and *Streptococcus* spp. recovered from the indoor air of a large-scale swine-feeding operation. *Lett Appl Microbiol*, 43(5), 534-540.
10. Sapkota AR, Curriero FC, Gibson KE, Schwab KJ (2007). Antibiotic-resistant enterococci and fecal indicators in surface water and groundwater impacted by a concentrated swine feeding operation. *Environ Health Perspect*, 115(7), 1040.
11. Gibbs SG, Green CF, Tarwater PM, Mota LC, et al. (2006). Isolation of antibiotic-resistant bacteria from the air plume downwind of a swine confined or concentrated animal feeding operation. *Environ Health Perspect*, 114(7), 1032.
12. Schulz J, Friese A, Klees S, Tenhagen BA, et al. (2012). Longitudinal study of the contamination of air and of soil surfaces in the vicinity of pig barns by livestock-associated methicillin-resistant *Staphylococcus aureus*. *Appl Environ Microbiol*, 78(16), 5666-5671.
13. Graham JP, Nachman KE (2010). Managing waste from confined animal feeding operations in the United States: The need for sanitary reform. *J Water Health*, 8(4), 646-670.
14. Smith TC, Gebreyes WA, Abley MJ, Harper AL, et al. (2013). Methicillin-resistant *Staphylococcus aureus* in pigs and farm workers on conventional and antibiotic-free swine farms in the USA. *PLoS One*, 8(5), e63704.
15. Rinsky JL, Nadimpalli M, Wing S, Hall D, et al. (2013). Livestock-associated methicillin and multidrug resistant *Staphylococcus aureus* is present among industrial, not antibiotic-free livestock operation workers in North Carolina. *PLoS One*, 8(7), e67641.
16. Rule AM, Evans SL, Silbergeld EK (2008). Food animal transport: A potential source of community exposures to health hazards from industrial farming (CAFOs). *J Infect Public Health*, 1(1), 33-39.
17. Costa D, Poeta P, Sáenz Y, Vinué L, et al. (2008). Mechanisms of antibiotic resistance in *Escherichia coli* isolates recovered from wild animals. *Microb Drug Resist*, 14(1), 71-77.

18. Literak I, Dolejska M, Radimersky T, Klimes J, et al. (2010). Antimicrobial-resistant faecal *Escherichia coli* in wild mammals in central Europe: Multiresistant *Escherichia coli* producing extended-spectrum beta-lactamases in wild boars. *J Appl Microbiol*, 108(5), 1702-1711.
19. Ramlachan N, Anderson R, Andrews K, Laban G, et al. (2007). Characterization of an antibiotic resistant *Clostridium hathewayi* strain from a continuous-flow exclusion chemostat culture derived from the cecal contents of a feral pig. *Anaerobe*, 13(3), 153-160.
20. Cosgrove SE (2006). The relationship between antimicrobial resistance and patient outcomes: mortality, length of hospital stay, and health care costs. *Clin Infect Dis*, 42(Supplement 2), S82-S89.
21. Cosgrove SE, Sakoulas G, Perencevich EN, Schwaber MJ, et al. (2003). Comparison of mortality associated with methicillin-resistant and methicillin-susceptible *Staphylococcus aureus* bacteremia: A meta-analysis. *Clin Infect Dis*, 36(1), 53-59.
22. McHugh CG, Riley LW (2004). Risk factors and costs associated with methicillin-resistant *Staphylococcus aureus* bloodstream infections. *Infect Control Hosp Epidemiol*, 25(5), 425-430.
23. Kim T, Oh PI, Simor AE (2001). The economic impact of methicillin-resistant *Staphylococcus aureus* in Canadian hospitals. *Infect Control Hosp Epidemiol*, 22(2), 99-104.
24. Gregory A, Filice, John A. Nyman, Catherine Lexau, Christine H. Lees, et al. (2010). Excess costs and utilization associated with methicillin resistance for patients with *Staphylococcus aureus* infection. *Infect Control Hosp Epidemiol*, 31(4), 365-373.
25. U.S. Food and Drug Administration (2013). *2011 Retail Meat Report: National Antimicrobial Resistance Monitoring System*. Available at <http://www.fda.gov/downloads/AnimalVeterinary/SafetyHealth/AntimicrobialResistance/NationalAntimicrobialResistanceMonitoringSystem/UCM334834.pdf>
26. Tadesse DA, Zhao S, Tong E, Ayers S, et al. (2012). Antimicrobial drug resistance in *Escherichia coli* from humans and food animals, United States, 1950–2002. *Emerg Infect Dis*, 18(5), 741.
27. Waters AE, Contente-Cuomo T, Buchhagen J, Liu CM, et al. (2011). Multidrug-resistant *Staphylococcus aureus* in US meat and poultry. *Clin Infect Dis*, 52(10), 1227-1230.
28. O'Brien AM, Hanson BM, Farina SA, Wu JY, et al. (2012). MRSA in conventional and alternative retail pork products. *PLoS One*, 7(1), e30092.
29. Collignon P (2013). Superbugs in food: A severe public health concern. *Lancet Infect Dis*, 13(8), 641-643.
30. Le Hello S, Harrois D, Bouchrif B, Sontag L, et al. (2013). Highly drug-resistant *Salmonella enterica* serotype Kentucky ST198-X1: A microbiological study. *Lancet Infect Dis*, 13(8), 672-679.
31. Dutil L, Irwin R, Finley R, Ng LK, et al. (2010). Ceftiofur resistance in *Salmonella enterica* serovar Heidelberg from chicken meat and humans, Canada. *Emerg Infect Dis*, 16(1), 48.
32. Nordstrom L, Liu CM, Price LB (2013). Foodborne urinary tract infections: A new paradigm for antimicrobial-resistant foodborne illness. *Front Microbiol*, 4(29), 1-6.
33. Russo TA, Johnson JR (2003). Medical and economic impact of extraintestinal infections due to *Escherichia coli*: Focus on an increasingly important endemic problem. *Microbes Infect*, 5(5), 449-456.
34. Foxman B (2002). Epidemiology of urinary tract infections: Incidence, morbidity, and economic costs. *Am J Med*, 113(1), 5-13.
35. Nachman KE, Graham JP, Price LB, Silbergeld EK (2005). Roxarsone, inorganic arsenic, and other arsenic species in chicken. *Environ Health Perspect*, 113(9), 1123-1124.
36. Nachman KE, Baron PA, Raber G, Francesconi KA, et al. (2013). Roxarsone, inorganic arsenic, and other arsenic species in chicken: A U.S.-based market basket sample. *Environ Health Perspect*, 121(7), 818-824.

37. Conklin S, Shockey N, Kubachka K, Howard K, et al. (2012). Development of an IC-ICP-MS method to determine inorganic arsenic in liver from chickens treated with roxarsone. *J Agric Food Chem*, 60(37), 9394-9404.
38. Aubrey A (2013). How trace amounts of arsenic end up in grocery store meat. *The Salt: What's on Your Plate*. National Public Radio. Available at <http://www.npr.org/blogs/thesalt/2013/05/15/184261664/how-trace-amounts-of-arsenic-end-up-in-grocery-store-meat>
39. Nachman KE, Raber G, Francesconi KA, Navas-Acien A, et al. (2012). Arsenic species in poultry feather meal. *Sci Total Environ*, 417-418, 183-188.
40. Price LB, Stegger M, Hasman H, Aziz M, et al. (2012). Staphylococcus aureus CC398: Host adaptation and emergence of methicillin resistance in livestock. *mBio*, 3(1), e00305-00311.
41. Luo Y, Mao D, Rysz M, Zhou Q, et al. (2010). Trends in antibiotic resistance genes occurrence in the Haihe River, China. *Environ Sci Technol*, 44(19), 7220-7225.
42. Wu N, Qiao M, Zhang B, Cheng W-D, et al. (2010). Abundance and diversity of tetracycline resistance genes in soils adjacent to representative swine feedlots in China. *Environ Sci Technol*, 44(18), 6933-6939.
43. Casey JA, Curriero FC, Cosgrove SE, Nachman KE, et al. (2013). High-density livestock operations, crop field application of manure, and risk of community-associated methicillin-resistant Staphylococcus aureus infection, Pennsylvania, USA. *JAMA Intern Med*.
44. Feingold BJ, Silbergeld EK, Curriero FC, van Cleef BA, et al. (2012). Livestock Density as risk factor for livestock-associated methicillin-resistant Staphylococcus aureus, the Netherlands. *Emerg Infect Dis*, 18(11), 1841.
45. Aarestrup F (2012). Sustainable farming: Get pigs off antibiotics. *Nature*, 486(7404), 465-466.
46. Preservation of Antibiotics for Medical Treatment Act of 2013, H.R. 1150, 113th Cong., 1st Sess. (2013).
47. Preventing Antibiotic Resistance Act of 2013, S. 1256, 113th Cong., 1st Sess. (2013).
48. Union of Concerned Scientists (2013). The Preservation of Antibiotics for Medical Treatment Act (PAMTA) Endorsers List. Retrieved Aug 9, 2013, from http://www.ucsusa.org/food_and_agriculture/solutions/strengthen-healthy-farm-policy/pamta-endorsers-list.html
49. Animal Drug User Fee Amendments of 2008, Pub. L. No. 110-316, § 105, 122 Stat. 3509 (2008).
50. U.S. Food and Drug Administration (2013). ADUFA reports. Retrieved Aug 9, 2013, from <http://www.fda.gov/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/ucm042896.htm>
51. U.S. Food and Drug Administration (2012). Animal Drug User Fee Act (ADUFA) public meeting. Retrieved Aug 9, 2013, from <http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM334981.pdf>
52. U.S. Food and Drug Administration (2011). Animal Drug User Fee Act (ADUFA) public meeting. Retrieved Aug 9, 2013, from <http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM282315.pdf>
53. U.S. Food and Drug Administration (2012). Animal Drug User Fee Act; public meeting; request for comments. *Fed Regist*, 77(234), 72356-72359.
54. U.S. Food and Drug Administration (2013). Proposed ADUFA III provisions of the Federal Food, Drug, and Cosmetic Act. Retrieved Aug 9, 2013, from <http://www.fda.gov/downloads/ForIndustry/UserFees/AnimalDrugUserFeeActADUFA/UCM343227.pdf>
55. U.S. Food and Drug Administration (2013). FDA announces the reauthorization of user fees to support timely and efficient review of animal drugs and generic animal drugs. Retrieved Aug 9, 2013, from <http://www.fda.gov/AnimalVeterinary/NewsEvents/CVMUpdates/ucm357130.htm>
56. Delivering Antimicrobial Transparency in Animals Act of 2013, H.R. 820, 113th Cong., 1st Sess. (2013).

57. Antimicrobial Data Collection Act, S. 895, 113th Cong., 1st Sess. (2013).
58. U.S. Food and Drug Administration (2012). *Guidance for Industry: The Judicious Use of Medically Important Antimicrobial Drugs in Food-Producing Animals*. #209. Available at <http://www.fda.gov/downloads/animalveterinary/guidancecomplianceenforcement/guidanceforindustry/ucm216936.pdf>
59. U.S. Food and Drug Administration (2013). *Guidance for Industry: New Animal Drugs and New Animal Drug Combination Products Administered in or on Medicated Feed or Drinking Water of Food-Producing Animals: Recommendations for Drug Sponsors for Voluntarily Aligning Product Use Conditions with GFI #209*. #213. Available at <http://www.fda.gov/downloads/AnimalVeterinary/GuidanceComplianceEnforcement/GuidanceforIndustry/UCM299624.pdf>
60. Lawrence RS (2012). The FDA did not do enough to restrict antibiotics use in animals. *The Atlantic*. Available at <http://www.theatlantic.com/health/archive/2012/04/the-fda-did-not-do-enough-to-restrict-antibiotics-use-in-animals/255878/>
61. Kar A (2012). FDA offers make-believe solution to antibiotic resistance. *Switchboard*. National Resource Defence Council. Available at http://switchboard.nrdc.org/blogs/akar/fda_offers_make-believe_soluti.html
62. Lawrence RS (2012). The FDA's willful evasion of science. *The Atlantic*. Available at <http://www.theatlantic.com/health/archive/2012/06/the-fdas-willful-evasion-of-science/258274/>
63. Lawrence RS (2012). The FDA enters withdrawal: The future of antibiotics on farms. *The Atlantic*. Available at <http://www.theatlantic.com/health/archive/2012/03/the-fda-enters-withdrawal-the-future-of-antibiotics-on-farms/255236/>
64. Mellon M (2013). Negotiating with drug companies: The horse-trading behind the FDA's voluntary program. *The Equation*. Union of Concerned Scientists. Available at <http://blog.ucsusa.org/negotiating-with-drug-companies-the-horse-trading-behind-the-fdas-voluntary-program>
65. U.S. Food and Drug Administration (2012). Veterinary feed directive; draft text for proposed regulation. *Fed Regist*, 77(72), 22247-22249.
66. U.S. Food and Drug Administration (2012). New animal drugs; cephalosporin drugs; extralabel animal drug use; order of prohibition. *Fed Regist*, 77(4), 735-745.
67. U.S. Food and Drug Administration (2008). New animal drugs; cephalosporin drugs; extralabel animal drug use; order of prohibition. *Fed Regist*, 73(129), 38110-38113.
68. U.S. Food and Drug Administration (2012). Antimicrobial animal drug sales and distribution reporting. *Fed Regist*, 77(145), 44177-44179.
69. Maryland Department of Agriculture (2013). Legislative Comment on SB 520. Retrieved September 27, 2013, from http://mda.maryland.gov/Documents/sb520_antimicrobial.pdf
70. Agriculture - Commercial Feed - Arsenic Prohibition, H.B. 167, Maryland General Assembly (2012).
71. A08145/S00591, New York State Legislature (2013).
72. H. 263, Vermont State Legislature (2013).
73. Natural Resources Defense Council (2011, May 25). Superbug suit: Groups sue FDA over risky use of human antibiotics in animal feed [Press release]. Available at <http://www.nrdc.org/media/2011/110525.asp>
74. Kar A (2011). Antibiotic resistance rising, but FDA can't resist letting industry have things its way. *Switchboard*. National Resources Defence Council. Available at http://switchboard.nrdc.org/blogs/akar/antibiotic_resistance_rising_b.html
75. Lawrence RS (2012). The rise of antibiotic resistance: Consequences of FDA's inaction. *The Atlantic*. Available at <http://www.theatlantic.com/health/archive/2012/01/the-rise-of-antibiotic-resistance-consequences-of-fdas-inaction/251754/>

76. U.S. Food and Drug Administration (2011). Withdrawal of notices of opportunity for a hearing; penicillin and tetracycline used in animal feed. *Fed Regist*, 76(246), 79697-79701.
77. Natural Resources Defense Council, et al. v. United States Food and Drug Administration, et al. 884 F.Supp.2d 127 (S.D.N.Y. 2012).
78. Natural Resources Defense Council, et al. v. US Food and Drug Administration, 872 F.Supp.2d 318 (S.D.N.Y. 2012).
79. Smith TJ (2012). Government accountability project sues FDA for antibiotic sales data. *Livable Future Blog*. <http://www.livablefutureblog.com/2012/12/government-accountability-project-sues-fda-for-antibiotic-sales-data>
80. Center for Food Safety (2013, May 1). FDA ignores toxic arsenic in animal feed [Press release]. Available at <http://www.centerforfoodsafety.org/press-releases/2161/fda-ignores-toxic-arsenic-in-animal-feed>
81. Food and Water Watch (2013, May 13). Food & Water Watch sues FDA for concealing records on arsenic in poultry feed [Press release]. Available at <http://foodandwaterwatch.org/pressreleases/food-water-watch-sues-fda-for-concealing-records-on-arsenic-in-poultry-feed/>
82. U.S. Food and Drug Administration (2011). *Analysts Report Amendment: Study Title: Provide data on various arsenic species present in broilers treated with roxarsone: Comparison with untreated birds*. Study No. 275.30. Available at <http://www.fda.gov/downloads/AnimalVeterinary/SafetyHealth/ProductSafetyInformation/UCM257547.pdf>
83. Tester J (2010, March 24). Tester introduces Meat Safety and Accountability Act [Press release]. Available at http://www.testersenate.gov/?p=press_release&id=909
84. Bottemiller H (2010). Wide support for traceback bill. *Food Safety News*. Retrieved August 5, 2013, from <http://www.foodsafetynews.com/2010/03/former-fsis-head-consumer-groups-back-traceback-bill/#.UZwhvCs4VKR>
85. Food Safety Modernization Act, Pub. L. No. 111-353, 124 Stat. 3885 (2011).
86. McEntire J, Bhatt T (2013). *Pilot Projects for Improving Product Tracing along the Food Supply System – Final Report*. Chicago, IL: Institute of Food Technologists. Available at <http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm270851.htm>
87. U.S. Food and Drug Administration (2013). Product tracing. Retrieved August 9, 2013, from <http://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm270851.htm>
88. U.S. Department of Agriculture (2009, April 30). Secretary Vilsack announces National Animal Identification System listening session locations [Press release]. Available at <http://www.aphis.usda.gov/newsroom/content/2009/04/seclisten.shtml>
89. U.S. Department of Agriculture (2012). Questions and answers: Animal disease traceability final rule. Retrieved September 26, 2013, from http://www.aphis.usda.gov/traceability/downloads/rule_movement_general.pdf
90. U.S. Department of Agriculture (2013). Traceability for livestock moving interstate; final rule. *Fed Regist*, 78(6), 2040-2075.
91. Food Safety and Inspection Service (2012). Changes to FSIS traceback, recall procedures for *Escherichia coli* O157:H7 positive raw beef product, and availability of compliance guidelines. *Fed Regist*, 77(88), 26725-26732.
92. U.S. Department of Agriculture (2012, May 2). USDA announces new safeguards to protect consumers from foodborne illness [Press release]. Available at <http://www.fsis.usda.gov/wps/portal/fsis/newsroom/news-releases-statements-and-transcripts/news-release-archives-by-year/news-release-archives-by-year-2012>
93. Farm and Ranch Freedom Alliance (2013). Texas Animal ID is back! Retrieved August 5, 2013, from <http://farmandranchfreedom.org/texas-animal-id-bills/>

94. U.S.Department of Agriculture (2005). *FY-2005 Annual Report Manure and Byproduct Utilization National Program 206*. Retrieved from <http://www.ars.usda.gov/SP2UserFiles/Program/206/NP206FY2005AnnualReport.pdf>.
95. Hoppin JA, Umbach DM, London SJ, Lynch CF, et al. (2006). Pesticides and adult respiratory outcomes in the agricultural health study. *Ann N Y Acad Sci*, 1076(1), 343-354.
96. Chee-Sanford JC, Mackie RI, Koike S, Krapac IG, et al. (2009). Fate and transport of antibiotic residues and antibiotic resistance genes following land application of manure waste. *J Environ Qual*, 38(3), 1086-1108.
97. Orlando EF, Kolok AS, Binzick GA, Gates JL, et al. (2004). Endocrine-disrupting effects of cattle feedlot effluent on an aquatic sentinel species, the fathead minnow. *Environ Health Perspect*, 112(3), 353.
98. Aneja VP, Chauhan J, Walker J (2000). Characterization of atmospheric ammonia emissions from swine waste storage and treatment lagoons. *J Geophys Res*, 105(D9), 11535-11545.
99. Thorne PS, Ansley AC, Perry SS (2009). Concentrations of bioaerosols, odors, and hydrogen sulfide inside and downwind from two types of swine livestock operations. *J Occup Environ Hyg*, 6(4), 211-220.
100. Ko G, Simmons I, Otto D, Likirdopulos CA, Worley-Davis L, et al. (2010). Endotoxin levels at swine farms using different waste treatment and management technologies. *Environ Sci Technol*, 44(9), 3442-3448.
101. Williams D, Breyse PN, McCormack MC, Diette GB, et al. (2011). Airborne cow allergen, ammonia and particulate matter at homes vary with distance to industrial scale dairy operations: An exposure assessment. *Environ Health*, 10, 72.
102. Peterka A (2013). Amendments roll in as Senate panel prepares to debate Farm Bill; EPA likely to be targeted. *Energy & Environment Daily*. E&E Publishing, LLC. Available at <http://www.eenews.net/stories/1059981102>
103. Grassley C (2013, May 22). Grassley amendments to Senate farm bill focus on EPA, payment limits, competition [Press release]. Available at http://www.grassley.senate.gov/news/Article.cfm?customel_dataPageID_1502=45978
104. Grassley C (2013, July 23). Grassley, Donnelly introduce legislation to keep check on EPA [Press release]. Available at http://www.grassley.senate.gov/news/Article.cfm?customel_dataPageID_1502=46614
105. Lawrence RS, Nachman KE, Williams DAL, McKenzie SE, et al. (2011, November 1). Letter to Representative Henry A. Waxman re: scientific evidence of adverse health effects linked to rural particulate matter. Available at http://democrats.energycommerce.house.gov/sites/default/files/image_uploads/Letter_JHU_11.03.11.pdf
106. U.S. Environmental Protection Agency (2013). CAFO Rule history. Retrieved August 5, 2013, from <http://cfpub.epa.gov/npdes/afo/aforule.cfm>
107. U.S. Environmental Protection Agency (2011). National Pollutant Discharge Elimination System (NPDES) concentrated animal feeding operation (CAFO) reporting rule. Retrieved August 5, 2013, from <http://www.gpo.gov/fdsys/pkg/FR-2011-10-21/html/2011-27189.htm>
108. Anderson K (2013). EPA asks groups to return CAFO info. *Brownfield: Ag News for America*. Retrieved August 5, 2013, from <http://brownfieldagnews.com/2013/04/09/epa-asks-groups-to-return-cafo-info/>
109. Devine J (2013). Seeking industrial livestock information is not "extreme." It's needed to protect U.S. waterways and human health. *Switchboard*. Natural Resources Defence Council. Available at http://switchboard.nrdc.org/blogs/jdevine/seeking_industrial_livestock_i.html
110. U.S. Senate Committee on Environment and Public Works (2013, April 4). Letter from Deb Fisher to EPA Acting Administrator Bob Perciasepe. Available at http://www.epw.senate.gov/public/index.cfm?FuseAction=Files.View&FileStore_id=29622852-f843-4442-8e07-10c291c9889a

111. Crawford R, Lucas F, Stockman S, Ribble R, et al. (2013, March 12). Letter to EPA Acting Administrator Bob Perciasepe. Available at http://crawford.house.gov/uploadedfiles/3.14.13_letter_to_epa_on_livestock_producer_info.pdf
112. National Pork Producers Council (2013, February 20). EPA releases confidential farm data [Press release]. Available at <http://www.nppc.org/2013/02/epa-releases-confidential-farm-data/>
113. U.S. Environmental Protection Agency (2009). CERCLA/EPCRA administrative reporting exemption for air releases of hazardous substances from animal waste at farms. Retrieved August 5, 2013, from http://www.epa.gov/emergencies/docs/chem/CAFO_rule_fact_sheet.pdf
114. U.S. Environmental Protection Agency (2008). CERCLA/EPCRA administrative reporting exemption for air releases of hazardous substances from animal waste at farms. *Fed Regist*, 73(244), 76948-76960.
115. U.S. Environmental Protection Agency (2012). Fact sheet - the National Air Emissions Monitoring Study: Data availability and call for additional information. Retrieved August 7, 2013, from <http://www.epa.gov/airquality/agmonitoring/fs20110113.html>
116. U.S. Environmental Protection Agency (2008). Large animal feeding operations: Reducing their impact on air quality. *Enforcement Alert*, 9(4).
117. Purdue University (2006). Introduction to NAEMS. *NAEMS: National Air Emissions Monitoring Study*. Retrieved August 7, 2013, from <https://engineering.purdue.edu/~odor/NAEMS/>
118. Lawrence R, Nachman K, Smith T, Williams DA, et al. (2011, March 7). Re: Comment on the development of emission-estimating methodologies for animal feeding operations (EPA-HQ-OAR-2010-0960) [Public comment]. Available at <http://www.regulations.gov/#.documentDetail;D=EPA-HQ-OAR-2010-0960-0006>
119. U.S. Environmental Protection Agency (2012). Draft Documents. *Agriculture - Air Monitoring*. Retrieved August 7, 2013, from <http://www.epa.gov/airquality/agmonitoring/techdocs.html>
120. Environmental Integrity Project (2011). Hazardous pollution from factory farms: An analysis of EPA's National Air Emissions Monitoring Study data. *Library Blog*. Resources for the Future. Available at <http://www.environmentalintegrity.org/documents/hazardouspollutionfromfactoryfarms.pdf>
121. U.S. Environmental Protection Agency Science Advisory Board (2013, April 19). Letter from David Allen to EPA Acting Administrator Bob Perciasepe. Available at [http://yosemite.epa.gov/sab/sabproduct.nsf/0/08A7FD5F8BD5D2FE85257B52004234FE/\\$File/EPA-SAB-13-003-unsigned+.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/0/08A7FD5F8BD5D2FE85257B52004234FE/$File/EPA-SAB-13-003-unsigned+.pdf)
122. U.S. Environmental Protection Agency (2010). *Chesapeake Bay TMDL Executive Summary*. Available at http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/BayTMDLExecutiveSummaryFINAL122910_final.pdf
123. U.S. Environmental Protection Agency (2013). How does it work? Ensuring results. Retrieved August 7, 2013, from <http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/EnsuringResults.html>
124. Chesapeake Bay Commission (2012). *Nutrient Credit Trading for the Chesapeake Bay: An Economic Study*. Available at <http://www.chesbay.us/Publications/nutrient-trading-2012.pdf>
125. Lawrence SR. (2012). Nutrient trading a dirty deal for the bay. *Baltimore Sun*. Available at http://articles.baltimoresun.com/2012-12-09/news/bs-ed-nutrient-trading-20121207_1_nutrient-output-nitrogen-and-phosphorus-nutrient-levels
126. Food and Water Watch (2012). Pollution trading and the Chesapeake Bay Total Maximum Daily Load. Retrieved August 7, 2013, from <http://www.foodandwaterwatch.org/common-resources/pollution-trading/>
127. S. 1411, Arizona State Legislature (2010).
128. Iowa Code, § 455B.103A (2013).
129. Mich. Comp. Laws, § 3109d (2011).
130. Mo. Rev. Stat., § 67.402, 226.720, 537.296 (2011).

131. U.S. Environmental Protection Agency (2008). State program requirements; Application to administer the National Pollutant Discharge Elimination System (NPDES) program for concentrated animal feeding operations (CAFOs); Ohio. Retrieved August 7, 2013, from <http://www.gpo.gov/fdsys/pkg/FR-2008-10-15/html/E8-24175.htm>
132. Animal Law Clinic of the Lewis & Clark Law School (2012). *Report on the Oregon Department of Agriculture's Enforcement of the Clean Water Act's NPDES program related to CAFOs*. Available at <http://law.lclark.edu/live/files/10807-2012-oda-clinic-report>
133. Wash. Rev. Code § 90.64.102 (2009).
134. 415 Ill. Comp. Stat. § 5/12.5 (2012).
135. Ind. Admin. Code tit. 355, article 7 (2010).
136. Ind. Admin. Code tit. 327, article 19 (2012).
137. U.S. Environmental Protection Agency (2013). Work plan to strengthen Illinois environmental programs. Retrieved August 7, 2013, from <http://www.epa.gov/region5/illinoisworkplan/>
138. N.M. Admin. Code 20.6.6 (2011).
139. Or. Rev. Stat. § 561.255 (2011).
140. California Regional Water Quality Control Board (2010). Board order no. R5-2010-0118 (as revised by Order R5-2011-0091) NPDES No. CAG015001. Retrieved August 7, 2013, from http://www.swrcb.ca.gov/rwqcb5/water_issues/dairies/dairy_program_regs_requirements/r5-2010-0118_rev_strike.pdf
141. Virginia Department of Conservation and Recreation (2013). Laws and regulations: Resource management plans. Retrieved August 7, 2013, from http://dcr.virginia.gov/laws_and_regulations/lr7.shtml
142. U.S. Department of Agriculture (2012, January 17). Secretary Vilsack signs historic agreement with EPA and State of Minnesota encouraging farmers to protect rivers, streams and lakes [Press release]. Available at <http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2012/01/0010.xml>
143. S.B. 1029, Maryland General Assembly (2013).
144. U.S. Environmental Protection Agency (2011, November 3). Testimony of Shawn M. Garvin, Regional Administrator, U.S. Environmental Protection Agency, Region III, before the Subcommittee on Conservation, Energy and Forestry, Committee on Agriculture, United States House of Representatives. Available at <http://agriculture.house.gov/sites/republicans.agriculture.house.gov/files/pdf/hearings/Garvin111103.pdf>
145. Pew Charitable Trusts (2013, March 19). Testimony in Opposition to SB 1029, Agriculture Certainty Program, before the Maryland Senate Committee on Education, Health, and Environmental Affairs. Available at http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Other_Resource/Ag-Certainty-SB-1029-Testimony-Final%203-19-2013.pdf
146. National Sustainable Agriculture Coalition (2011). Michigan court rules state can require CAFO permits before a spill. *CAFO Litigation Update*. Retrieved August 7, 2013, from <http://sustainableagriculture.net/blog/cafo-litigation-update/>
147. State of Michigan Court of Appeals (2011). Court Opinion No. 290323. from http://publicdocs.courts.mi.gov:81/OPINIONS/FINAL/COA/20110329_C290323_30_43O-290323-FINAL.PDF
148. Michigan Department of Environmental Quality (2010). NPDES CAFO permit. *Michigan Business One Stop*. Retrieved August 7, 2013, from http://michigan.gov/statelicensesearch/0,1607,7-180-24786_24820-245064-,00.html
149. Title 40 - Protection of Environment § 261.4 (2012).

150. U.S. District Court for the Eastern District of Washington (2013). No. CV-13-3016-TOR: First amended complaint. Retrieved August 8, 2013, from http://www.centerforfoodsafety.org/files/2013-04-16-dkt-37--pls-first-amended-complaint_46961.pdf
151. Center for Food Safety (2013, February 15). Groups file lawsuits to stop groundwater pollution from industrial dairies [Press release]. Available at <http://www.centerforfoodsafety.org/issues/976/ge-food-labeling/press-releases/1244/groups-file-lawsuits-to-stop-groundwater-pollution-from-industrial-dairies>
152. Waterkeeper Alliance (2010, March 2). Major lawsuit filed to protect Maryland waterways [Press release]. Available at <http://www.waterkeeper.org/ht/display/ContentDetails/i/16673/pid/221>
153. Save Family Farms (2013). Lawsuit update. Retrieved August 8, 2013, from <http://savefarmfamilies.org/>
154. O'Malley M (2011, November 14). Letter to Dean Phoebe Haddon. Available at http://savefarmfamilies.org/wp-content/themes/news/pdfs/MD_Dean_Haddon_Letter.pdf
155. U.S. District Court for the District of Maryland (2012). Civil Action No. WMN-10-487 Retrieved August 8, 2013, from http://www.gpo.gov/fdsys/pkg/USCOURTS-mdd-1_10-cv-00487/pdf/USCOURTS-mdd-1_10-cv-00487-2.pdf
156. Wheeler T. (2013). Eastern Shore farmer, Perdue seek attorneys' fees. *Baltimore Sun*. Available at http://articles.baltimoresun.com/2013-02-07/features/bs-gr-waterkeeper-lawsuit-fees-20130207_1_waterkeeper-group-waterkeeper-alliance-pile-of-chicken-manure
157. U.S. District Court Northern District of Florida Talahassee Division (2009). CASE NO. 4:08-cv-00324-RH-WCS Retrieved August 8, 2013, from http://earthjustice.org/sites/default/files/library/legal_docs/env_defense-434740-v1-fwf_v_epa_-_signed_cd.pdf
158. Butler County Dairy, LLC v. Butler County, 827 N.W.2d 267 (2013).
159. U.S. District Court Eastern District of Washington (2012). No. CV-04-3060-LRS Order on Relief. Retrieved August 8, 2013, from <http://charliettebbutt.com/files/fariarelieforder.pdf>
160. Appellate Court of Illinois Second District (2010). Appeal from the Circuit Court of Jo Daviess County, No. 08--CH--42. Retrieved August 8, 2013, from <http://www.state.il.us/court/opinions/AppellateCourt/2010/2ndDistrict/December/2091283.pdf>
161. Rochester Buckhart Action Group v. Young, 914 N.E.2d 1251 (2009).
162. Supreme Court of Wisconsin (2012). Case No.: 2009AP608. Retrieved August 8, 2013, from <http://www.wicourts.gov/sc/opinion/DisplayDocument.pdf?content=pdf&seqNo=84725>
163. Egg Products Inspection Act Amendments of 2013, H.R. 3798, 113th Cong., 1st Sess. (2012).
164. Rogers D (2013). Draft farm bill aids pork, beef lobbies. *Politico*. Available at http://www.politico.com/story/2013/05/draft-farm-bill-aids-pork-beef-lobbies-91164_Page2.html
165. Farm Sanctuary (2012). The hens need your help. Retrieved August 9, 2013, from http://farmsanctuary.org/wp-content/uploads/2012/07/FAP_FarmSanctuary_Flier_01_12_HRez.pdf
166. Wasson E (2012). Midnight egg amendment in 2012 farm bill escalates animal rights fight. *The Hill*. Available at <http://thehill.com/blogs/on-the-money/budget/237939-midnight-egg-amendment-in-2012-farm-bill-escalates-animal-rights-fight>
167. King S (2012). King-- T12 Prohibition against interference by state and local governments with production or manufacture of items in other states. Retrieved August 9, 2013, from <http://static.ewg.org/pdf/045King-T12-Prohibition-Against-Interference-by-State-and-Local-Governments-with-Production-or-Manufacture-of-items-in-other-States.pdf>
168. A.B. 1437, California State Legislature (2010).

169. League of Women Voters of California Education Fund (2008). Proposition 2: Standards for confining farm animals, State of California. Retrieved August 9, 2013, from <http://www.smartvoter.org/2008/11/04/ca/state/prop/2/>
170. California State Legislature (2008). Text of Proposed Laws: Proposition 2. Retrieved August 9, 2013, from <http://vig.cdn.sos.ca.gov/2008/general/text-proposed-laws/text-of-proposed-laws.pdf#prop2>
171. Humane Society of the United States (2013). Anti-whistleblower bills hide factory farming abuses from the public. Retrieved August 9, 2013, from http://www.humanesociety.org/issues/campaigns/factory_farming/fact-sheets/ag_gag.html#id=album-185&num=content-3312
172. NC Commerce Protection Act of 2013, S. 648, North Carolina General Assembly (2013).
173. Flynn D (2013). Governor Haslam's 'ag-gag' veto could have national impact. *Food Safety News*. Retrieved August 9, 2013, from <http://www.foodsafetynews.com/2013/05/tennessee-veto-could-have-national-impact-in-animal-abuse-debate/#.UZv0ESs4VKQ>
174. Utah Code § 76 6-112 (2012).
175. S.B. 631, Missouri General Assembly (2012).
176. Glionna JM. (2013). Video of Utah slaughterhouse draws attention to 'ag-gag' laws. *Los Angeles Times*. Available at <http://www.latimes.com/news/nation/nationnow/la-na-nn-utah-ag-gag-law-uproar-20130502,0,7112289.story>
177. Keefe LM. (2013). Editorial: Wrong battle. *Meatingplace*. Available at <http://mydigimag.rrd.com/article/Editorial/1359010/153006/article.html>
178. U.S. Department of Agriculture (2011). 9 CFR Part 201. Retrieved August 9, 2013, from http://www.gipsa.usda.gov/Farmbill/final%20rule%20FR%20preview%202011-31618_PI.pdf
179. Food, Conservation, and Energy Act of 2008, H.R. 6124, 110th Cong., 2nd Sess. (2009).
180. National Sustainable Agriculture Coalition (2012). Bill to ban packer ownership of livestock introduced. Retrieved August 9, 2013, from <http://sustainableagriculture.net/blog/packer-ban-bill-introduced/>
181. National Sustainable Agriculture Coalition (2012). National sign-on letter in support of packer ban. Retrieved August 9, 2013, from <http://sustainableagriculture.net/wp-content/uploads/2012/06/National-sign-on-letter-in-support-of-Packer-Ban-5-31-12-2.pdf>
182. National Sustainable Agriculture Coalition (2011). Livestock Marketing Fairness Act introduced in House. Retrieved August 9 2013, from <http://sustainableagriculture.net/blog/livestock-fairness-bill/>
183. Livestock Marketing Fairness Act, S. 1086, 111th Cong., 1st Sess. (2009).
184. U.S. Department of Justice (2010). Public workshops: Agriculture and antitrust enforcement issues in our 21st century economy. Retrieved August 9, 2013, from <http://www.justice.gov/atr/public/workshops/ag2010/index.html>
185. U.S. Department of Justice (2012). *Competition and Agriculture: Voices from the Workshops on Agriculture and Antitrust Enforcement in our 21st Century Economy and Thoughts on the Way Forward*. Available at <http://www.justice.gov/atr/public/reports/283291.pdf>
186. U.S. Department of Agriculture (2010). Grain inspection, packers and stockyards administration, 9 CFR Part 201. *Fed Regist*, 75(119), 35338-35354.
187. U.S. Department of Agriculture (2011). Implementation of regulations required under Title XI of the Food, Conservation and Energy Act of 2008; suspension of delivery of birds, additional capital investment criteria, breach of contract, and arbitration. *Fed Regist*, 76(237), 76874-76890.
188. U.S. Department of Agriculture (2011, December 8). USDA implements provisions from 2008 Farm Bill to protect livestock and poultry producers [Press release]. Available at <http://www.gipsa.usda.gov/Farmbill/1208%2011%20%20GIPSA%20PRFinal.pdf>

189. Consolidated and Further Continuing Appropriations Act, 2013, Pub. L. No. 113–6 (2013).
190. Greene JL (2013). USDA's "GIPSA Rule" on livestock and poultry marketing practices Retrieved August 9, 2013, from <http://agriculture-legislation.blogspot.com/2013/03/usdas-gipsa-rule-on-livestock-and.html>
191. Hagstrom J (2013). House Ag Committee approves farm bill. *Agweek*. Retrieved August 9, 2013, from <http://www.agweek.com/event/article/id/20912/>
192. U.S. Department of Agriculture (2011). 9 CFR Parts 321, 332, and 381: Cooperative inspection programs: Interstate shipment of meat and poultry product; final rule. *Fed Regist*, 76(84), 24714-24759.
193. National Sustainable Agriculture Coalition (2011). Final rule for interstate shipment of state-inspected meat and poultry announced. Retrieved August 9, 2013, from <http://sustainableagriculture.net/blog/final-rule-interstate-meat/>
194. Harris A. (2011). Kraft, Kellogg sue egg companies claiming antitrust breach. *Bloomberg*. Available at <http://www.bloomberg.com/news/2011-12-13/kraft-kellogg-nestle-sue-egg-producers-over-pricing.html>
195. Compassion Over Killing (2011). National Milk Producers Federation and other dairy industry groups accused of antitrust violations. Retrieved August 9, 2013, from <http://www.cok.net/inv/dairy-lawsuit/>
196. Lowe P (2013). Dairy farmers of America settles price-fixing suit. *Kansas City Public Media*. Retrieved August 9, 2013, from <http://kcur.org/post/dairy-farmers-america-settles-price-fixing-suit>
197. Farm Futures (2012). Coalition: Proposed JBS, XL beef merger harmful. Retrieved August 9, 2013, from <http://farmfutures.com/story-coalition-proposed-jbs-xl-beef-merger-harmful-0-72075>
198. R-CALF USA (2013, March 29). Justice Department fails to stop ongoing monopolization of beefpacking industry [Press release]. Available at http://www.r-calfusa.com/news_releases/2013/130329Justice.htm
199. Agricultural Missions Inc. (2012, December 21). Letter to Attorney General Holder and Acting Assistant Attorney General Hesse. Available at http://cdn.e2ma.net/userdata/5030/assets/docs/coalition_letter_to_doj_re_jbs_and_xl_merger.pdf
200. U.S. Department of Treasury (2010). Process overview. *Resource Center*. Retrieved August 9, 2013, from <http://www.treasury.gov/resource-center/international/foreign-investment/Pages/cfius-overview.aspx>
201. Fuglie K, Heisey P, King J, Day-Rubenstein K, et al. (2011). *Research Investments and Market Structure in the Food Processing, Agricultural Input, and Biofuel Industries Worldwide*. ERR-130. Available at <http://www.ers.usda.gov/publications/err-economic-research-report/err130.aspx#.UkW7m9LhLT0>
202. U.S. Department of Agriculture (2013). Selected CRIS funding summaries. Retrieved August 9, 2013, from <http://cris.nifa.usda.gov/fsummaries.html#2011>
203. Schimmelpfenning D, Heisey PW (2009). *U.S. Public Agricultural Research: Changes in Funding Sources and Shifts in Emphasis, 1980-2005*. U.S. Department of Agriculture. EIB-45. Available at <http://www.ers.usda.gov/publications/eib-economic-information-bulletin/eib45.aspx#.UkW8NtLhLT0>
204. National Institutes of Health (2013). Research portfolio online reporting tools (RePORT). Retrieved August 9, 2013, from <http://report.nih.gov/index.aspx>
205. Agrawal T, Stern A. (2012). Bankrupt processor cites "pink slime" uproar. *Reuters*. Available at <http://www.reuters.com/article/2012/04/02/us-afafoods-bankruptcy-idUSBRE8310HX20120402>

References (Afterword)

1. Lubchenco J (1998). Entering the century of the environment: A new social contract for science. *Science*, 279(5350), 491-497.
2. Walker B, Salt D (2006). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington, D.C.: Island Press.
3. Schusky EL (1989). *Culture and Agriculture: An Ecological Introduction to Traditional and Modern Farming Systems*. New York: Bergin & Garvey Publishers.
4. Klare MT (2012). *The Race for What's Left: The Global Scramble for the World's Last Resources*. New York: Metropolitan Books.
5. Kelly M (2012). *Owning Our Future: The Emerging Ownership Revolution*. San Francisco: Berrett-Koehler Publishers.
6. Diamond JM (2005). *Collapse: How Societies Choose to Fail or Succeed*. New York: Viking.
7. Benyus JM (1997). *Biomimicry: Innovation Inspired by Nature*. New York: William Morrow.
8. Reichenberger L (2013). Cover crop magic. *The Furrow*, February, 10-13.
9. Liebman M (2012). Longer rotations are profitable, sustainable. *Leopold Letter*, 24(4).
10. Asbjornsen H, Hernandez-Santana V, Liebman M, Bayala J, et al. (2013). Targeting perennial vegetation in agricultural landscapes for enhancing ecosystem services. *Renewable Agriculture and Food Systems*.
11. Liebman M, Helmers MJ, Schulte LA, Chase CA (2013). Using biodiversity to link agricultural productivity with environmental quality: Results from three field experiments in Iowa. *Renewable Agriculture and Food Systems*, 28(2), 115-128.
12. Furuno T (2001). *The Power of Duck: Integrated Rice and Duck Farming*. Sisters Creek, Tasmania, Australia: Tagari Publications.
13. Perfecto I, Vandermeer J, Wright A (2009). *Nature's Matrix: Linking Agriculture, Conservation and Food Sovereignty*. Sterling, VA: Earthscan.
14. Leopold A (1949). *A Sand County Almanac*. New York: Oxford University Press.
15. Louv R (2007). *Leave no child inside*. *Orion*.
16. Wessels T (2006). *The Myth of Progress: Toward a Sustainable Future*. Burlington, Vermont: University of Vermont Press.

Appendix: List of Commissioners

Pew Commission on Industrial Farm Animal Production

John Carlin (Chair)

Michael Blackwell

Brother David Andrews

Fedele Bauccio

Tom Dempster

Dan Glickman

Alan Goldberg

John Hatch

Dan Jackson

Frederick Kirschenmann

James Merchant

Marion Nestle

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