

THE ART AND SCIENCE OF ENVIRONMENTAL LEGISLATION

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INTRODUCTION

Current political debate over environmental issues often turns on disputes over the credibility of scientific research and analysis. One need only look at any week's headlines or political advertisements to see the wide range of issues dominated by arguments over what constitutes "good science" -- including global warming, clean air, clean water, pesticides, and endangered species. In this paper, I discuss generally how scientific uncertainty and disputes over science affect and are accommodated by the legislative process, and illustrate this discussion with my experiences in drafting and defending an environmental bill that has received widespread attention.

Environmental legislation invokes science both in its goals and its methods, and either or both may generate fierce debate. The legislator must first determine whether there are defensible scientific grounds for asserting that an environmental problem exists, and then defend specific policy choices reflected in a bill that proposes to address the problem. Even if there is general agreement that an environmental problem exists, debate over the specific mechanisms of a bill may obscure its fundamental aims.

Opponents of proposed legislation or regulation frequently plead for "good science" to be employed. Of course, the implication is that whatever science is currently relied upon is "bad." Because most scientific issues are the subject of a certain amount of legitimate and expected debate, typically it is not difficult to call into question the science underlying the methods adopted by a particular bill. It is a short step from there to question whether the

goals of the legislation are justified or even whether the lawmaker is disingenuously invoking science to achieve some other tacit "political" goal.¹ Not surprisingly, this approach often seems to short circuit meaningful discussion of the science itself and instead further polarizes the positions.

It should be noted that enactment of law usually is not the only goal of a legislator. While any serious legislator strives to introduce legislation worthy of enactment, the simple introduction of a bill may bring new attention to an issue; influence national debate; drive scientific research; press an industry into voluntary action; or encourage a regulatory agency to take the initiative. If a legislator believes an issue demands attention, then even the initial debate over a new bill is a big step forward. Because the current politics of science may subject an environmental bill to immediate scrutiny and extensive discussion, it is clear that lawmakers must carefully deliberate scientific issues and be prepared to defend their legislation.

Few legislators are practicing scientists, and there can be no reasonable expectation that a legislator is capable of independently investigating scientific issues. Yet legislators, by virtue of their elected office, are vested with the responsibility of assessing environmental information and making policy and legislative decisions accordingly. They play a pivotal role in passing judgment on whether a given body of scientific knowledge requires legislative action or whether proposed legislation is justified by known science.

For scientists trained in the rigor of scientific inquiry and subject to the careful scrutiny of their peers, it may be frustrating that there are no rules that govern a legislator's actions on scientific issues -- any bill may be introduced, regardless of merit. Nonetheless, an individual lawmaker is not the final arbiter of legislation and the political system ultimately demands a high level of accountability for legislators. Of course, a bill must survive debate in both houses of Congress and be signed by the President to become law. Immediately upon introduction, a bill is subject to scrutiny by scientists, constituents, and environmental advocates, as well as those who might face additional regulation.

Does the legislation reflect the findings of recognized authorities? Will proposed restrictions have measurable environmental benefits that justify the costs? Are the proposed regulatory mechanisms feasible? Because the answers to these and many other questions determine the credibility of legislation, legislators and their staff must turn to a wide variety of sources for information and advice, including university researchers, industry associations, environmental advocates, individual companies, and government agencies.

At its best, a bill reflects the informed judgment of conscientious lawmakers and staff who have educated themselves and become fluent in the scientific issues by studying the issues, reviewing reports of scientific data, listening carefully to criticisms of the reports, and consulting with the widest possible range of people. Legislators also may rely on the nonpartisan staff of the Library of Congress or on the analysis of outside experts recruited specifically for their advice. This is the way a legislator must evaluate any issue, scientific or not -- ultimately the legislator makes a judgment about whether the weight of the available information supports a credible case for legislation.

Drafting legislation is an inexact science, but it is important to note that a legislator need not be the final arbiter of debate over every relevant scientific issue. Typically a bill will delegate regulatory authority to an administrative agency, leaving decisionmaking on a number of specific issues to agency staff. By setting parameters within which administrative rules must fall, legislation can accomplish its broader policy goals while deferring to the expertise of an agency on particular issues, especially on issues where it is clear that more scientific

analysis is needed. In addition, leaving specific decisions at the regulatory rather than statutory level ensures greater flexibility for changes to be made to standards over time, as new information is learned or other factors change.

THE ANIMAL AGRICULTURE REFORM ACT

All of these general principles can be illustrated by examples drawn from my experience drafting and defending the Animal Agriculture Reform Act of 1997 (S. 1323). I will give some background on the issue, explain some of the major criticisms raised against the bill on scientific grounds, and describe the way in which judgments were made about those scientific issues.

In the past few years, there have been increasing concerns about the potential for animal waste pollution from livestock and poultry operations. The growing concentration of more and more animals in certain regions of the country and on larger operations has raised greater challenges for manure management, and increasing reports of water pollution have fueled a growing public opinion that more environmental protections are needed.

The primary environmental impact of poorly managed livestock operations is nutrient pollution -- excessive amounts of nitrogen and phosphorous running off into surface waters or leaching into ground water. Serious incidents of pollution can occur from spills that occur when manure storage lagoons breach, equipment breaks, or people make mistakes, but the larger problem is chronic runoff of manure from crop land. The excessive growth and decay of algae and other aquatic organisms that feed on excessive nutrients in water deplete dissolved oxygen. The resulting hypoxia from chronic nutrient enrichment can severely degrade water quality and aquatic environments.

Senator Tom Harkin of Iowa, ranking member of the Agriculture Committee, asked his committee staff to investigate this issue because he had been hearing directly from his constituents about these environmental concerns in Iowa. We wanted to find out if this was an issue of national scope and, if so, whether new environmental policies should be advanced at the national level.

Over the course of months, we talked to officials in numerous states and federal agencies, reviewed research and newspaper articles from around the country and the world, and listened carefully to discussions of these issues

by those in the livestock and poultry industries. In summary, we found that animal feeding operations are considered a leading agricultural polluter.

Based on state reports, the U.S. Environmental Protection Agency estimates that agriculture is the largest nonpoint source polluter, contributing to 70% of all water quality problems identified in rivers and streams. Within agriculture, animal feeding operations are the second largest polluter (behind crop production). Data compiled by the United States Geological Survey indicates that manure contributes a large percentage of the nutrient loading in rivers and streams from nonpoint sources, and in some cases contributes the majority of those nutrients.

Furthermore, evidence from around the country suggested that eutrophication of surface and ground water was a significant problem. The presence of a "dead zone" of hypoxia in the Gulf of Mexico has been documented for years, attributed largely to agricultural runoff in the Mississippi River watershed. Scientists suggest that increasing levels of toxic algae and microbes in coastal and estuarine waters around the country may be due to nutrient enrichment from runoff into those waters. In specific places, such as Tulsa, Oklahoma, the quality of drinking water supplies is being degraded by nutrient pollution attributed to manure runoff.

This accumulation of data, combined with continued reports of manure spills around the country, indicated clearly that poor environmental practices were making the livestock industry a substantial source of pollution. Dairy farms in New York, California, and Washington, poultry farms around the Chesapeake Bay, and hog farms in North Carolina and Iowa were just some of the places where manure management was reported as an environmental problem.

We concluded that the environmental impacts of animal agriculture were significant and widespread, and that current national standards were insufficient. While EPA regulations setting water pollution standards for animal feeding operations have been on the books since the 1970's, the EPA Inspector General reported in 1997 that: "Federal regulations inadequately protect water quality from animal waste."ⁱⁱ

It also became clear that there are issues in the debate over animal agriculture that are not just about the environment. Smaller producers are feeling squeezed out by large companies. Neighbors are upset by new and expanding

facilities. The commitment of corporate operations to be good citizens is being questioned. Although it is difficult to talk about environmental problems in the livestock industry without implicating these other socioeconomic questions, our task was to draft a national approach to environmental protection that to every extent possible would focus simply on the environment.

An initial question that we considered was whether crop production, as the leading agricultural polluter, should be a higher environmental priority than animal agriculture. While this question has not been a large factor in the current debate on this issue, it is an obvious one that should be considered. Although Senator Harkin has stated clearly that all sources of nutrient pollution need to be addressed, several factors led us to conclude that animal agriculture presented challenges that were both more pressing and more complex than those from crop production.

First, changing production practices in the livestock industry are intensifying environmental challenges. The national trend toward fewer operations, with more animals per operation and a lower average land base (upon which crops could be grown to utilize manure), means that in some areas there is a surplus of manure -- more manure than can be safely applied on nearby crop land. In 1997 the U.S. Department of Agriculture reported that: "The continued intensification of animal production systems without regard to the adequacy of the available land base for manure recycling presents a serious policy problem."ⁱⁱⁱ

This move toward specialized farms -- raising only livestock, not crops -- means that an increasing number of animal feeding operations are not dependent on a particular land base but can locate anywhere that makes economic sense, taking into account access to feed supplies, processing plants, inexpensive land, etc. This increasing mobility has resulted in rapid intensification of livestock production in certain areas of the country, which in turn has limited many producers' ability to move manure to land where it can be safely utilized.

Second, the economic incentives of nutrient management are substantially different between crop production and animal agriculture. Controlling nutrient use in crop production is primarily a matter of managing fertilizer inputs, so the cost savings from reducing commercial

fertilizer use are an economic incentive for better management practices. While this incentive alone may not outweigh producers' concerns about ensuring maximum crop yields, nonetheless it is an economic driver that with increased education and technical assistance should encourage the adoption of better management practices. In animal production, however, the nutrient supply from manure is an output of the operation, determined not by the producer's crop nutrient needs but by the number of animals raised. Unless the regulatory system adequately controls the use and disposal of the nutrient output, there is little incentive for individual producers to compensate for the imbalances between manure production and crop needs by limiting land application and seeking alternative uses for manure.

Finally, although a number of states have developed environmental regulations specifically focused on animal agriculture and many more states are considering such regulations, the rapid intensification of livestock operations in some areas of the country has outpaced some states' ability to enact adequate regulations. As a matter of environmental policy, Senator Harkin concluded that a minimum national standard for animal agriculture was necessary to ensure an even economic playing field for producers when it comes to environmental regulation. Secretary of Agriculture Dan Glickman echoed this concern when he stated in May of this year that: "We also see a mass migration of large livestock operations to regions with the least rules, leaving our communities with separate and unequal environmental and health protections."^{iv}

In brief, the Animal Agriculture Reform Act (S. 1323) would set national minimum environmental standards for animal feeding operations. The bill would require that larger animal feeding operations develop manure and nutrient management plans under standards for best management practices developed by the U.S. Department of Agriculture.^v Each manure and nutrient management plan would be site-specific, developed by each operation to take into account its own soils, its own crop production, its own weather, and all other unique factors. Manure application to land would be limited if it would exceed the operation's crop nutrient needs and threaten water or soil quality. The overarching goal of the legislation is to encourage that manure be used as a fertilizer wherever possible, but then kept off of land where it cannot be

utilized.

There has not been scientific criticism of the bill over the general approach it takes to management plans. These are the kind of management plans widely recommended by conservation advisors and already adopted in one form or another by many producers (and by regulatory requirement in some states). To a large extent, the bill defers to agency expertise to resolve scientific debates and develop standards for such issues as soil and manure nutrient tests, manure application methods that optimize nutrient use and minimize pollution, estimates of nutrient uptake rates for different crops, and predictions of nutrient movement in soils.

Nonetheless, some have objected to the establishment of standards for farm practices, believing that national policy should establish performance (environmental impact) standards to be met by producers by any effective practice they choose. For two general reasons, we chose not to adopt performance standards. First, current EPA regulations, which do establish a performance standard of "no discharge,"^{vi} have been criticized by the EPA's own Inspector General for failing to include specific requirements for management practices, including construction standards and manure handling and land application practices.^{vi} Current shortfalls in national regulation are not due to the lack of a performance standard, but to the lack of specific requirements that producers should follow to achieve those performance standards.

Second, performance standards would be much harder to establish and monitor than practice standards. Since the goal is reduction of nonpoint pollution from manure, performance standards would have to set criteria for some measurement of nonpoint pollution, such as edge of field runoff levels. Edge of field runoff varies according to many factors, including rainfall, topography, and soil type, and is probably a relevant measure only at certain times during and shortly following manure application, and would be virtually impossible to monitor in any meaningful way. Other performance criteria, such as nutrient concentrations in adjacent waterways, pose similar problems. On the other hand, setting standards for practices known to minimize runoff is simpler and the application of those practices is easier to monitor.

Furthermore, the producer is not held accountable for environmental conditions, but only for best management practices over which he has direct control.

An example of how we tried to strike a balance between setting policy and deferring to scientific expertise is the way the bill addresses the issue of earthen manure storage lagoons. When we began to deliberate over this issue, it was clear that the livestock industry and environmental advocates held very different opinions about the environmental soundness of lagoons. Industry representatives stated that a properly constructed lagoon would not pose a threat to the environment. Environmental advocates, on the other hand, called for the prohibition of lagoons, citing incidents in which lagoons had breached and studies showing elevated nitrate levels in ground water in the vicinity of lagoons.

Although it is clear that faulty management can play a big role in pollution from lagoons, we were convinced that reports of lagoon breaches and leaching raised questions about their fundamental environmental soundness. When we turned to USDA engineers and conservation specialists for further guidance, however, they told us that a properly constructed lagoon can ensure environmental protection. Based on that opinion, which obviously reflected professional expertise we did not have, we concluded that the appropriate approach would not be to ban lagoons, but to ensure that they were, in fact, constructed according to appropriate standards.

Instead of phasing out lagoons completely, the bill prohibits manure storage systems from being located below ground water levels and requires USDA to establish construction standards and minimum setbacks from environmentally sensitive areas (such as surface water, supply wells, drainage lines, etc.). Lagoons not meeting USDA's standards for safe siting in environmentally sensitive areas would have to be phased out. In this manner, we felt that the bill could set parameters for sound lagoon construction, but defer to agency expertise to establish specific criteria within those parameters.

Limiting land application of manure to minimize water pollution is at the heart of the bill, and also is the issue that raised the most scientific uncertainty. While there could be little disagreement that application of nutrients from

manure should be limited when soil or water quality would be threatened, there was plenty of disagreement about where application limits should be set to protect soil and water quality.

First, the behaviors of phosphorous and nitrogen in the environment are complex and vary considerably by soil type, rainfall, type of crop cover, application method, etc. Therefore, the difficulty of measuring and modeling nutrient behavior make it difficult to establish a standard for nutrient application. Second, application rates could be based on at least several factors, including crop nutrient needs, soil nutrient capacity, current soil nutrient levels, and nutrient levels in surrounding waterways.

Once we became versed in these complexities, it was obvious that the determination of actual nutrient application limits would have to be delegated to agency agronomists and conservationists. The approach the bill contemplates is one roughly analogous to the soil conservation formula known as the Universal Soil Loss Equation -- an equation that calculates the soil erodibility of a particular area site using site-specific factors like soil type and crop residue. To set the nutrient application standards required by the Animal Agriculture Reform Act, USDA would have to determine a formula or methodology that could calculate maximum nutrient application rates based on the operation-specific information recorded in the manure management plans (including location and flow of surface water, direction and degree of land slopes, a schedule of crops to be grown and estimate nutrient utilization rates, soil nutrient test results, and manure application methods). While this is clearly no simple task, it is the only approach which offers both uniformity of standards and flexibility for livestock producers to plan around the specific circumstances of their operation.

We also believed it was important to write into the bill a restriction on the nutrient application formula that would give producers an additional measure of flexibility. If application limits were based on crop nutrient needs alone, producers in many areas where soil nutrient levels are already very high would be greatly restricted from spreading manure on a regular basis in the future. Therefore, we made a policy decision that producers should be allowed to boost soil nutrient levels above crop nutrient needs where water quality would not be significantly impaired. The relevant provision of the bill states that manure may not be applied to land if nitrogen or phosphorous in the manure would be applied in a quantity

that both: exceeds the quantity necessary to meet crop nutrient requirements and significantly increases the risk of increased soil toxicity or the pollution of surface or ground water.⁶ Although this practice could speed up the onset of nutrient saturation, and therefore create a more imminent risk of nutrient runoff, we judged that it would be more important to maximize the ability of all producers to spread manure and minimize the immediate impact of application limits on their operations.

The most vigorous opposition to the Animal Agriculture Reform Act, however, has been based not specifically on a scientific issue, but on the perception by some that the bill's real purpose was political and not environmental. The pork industry, in particular, stated that the legislation was an attempt to address social and economic issues in the livestock industry rather than solutions to environmental problems. Indeed, the pork industry has been under intense political pressure in a number of states because of public concerns about the intensification of production and its impact on the environment, public health, property values, smaller producers, and the rural economy. There does not seem to be a clear cut argument why the environmental restrictions proposed in the bill, as opposed to some alternative method of curbing excessive manure application, can be said to be aimed primarily at changing the structure or growth of the livestock industry.

It is true that restrictions on land application of manure would require that some livestock operations either secure the use of more land for manure application or find alternative uses for manure. Although the amount of land needed under those restrictions should be proportional to the number of animals, regardless of the size of the operation (assuming similar crop use, etc.), smaller operations might have relatively lower compliance costs because they might not need to transport manure as far to find available land. To the extent that that is true, then environmental restrictions might be a relatively higher hurdle for larger operations and could be a disincentive to large, concentrated operations. On the other hand, the trend toward larger operations indicates that they provide economic efficiencies, which could allow those producers to absorb some higher environmental compliance costs.

The economic impact of the bill on the livestock industry is clearly of fundamental concern, but the bottom line is that careful environmental management of manure simply

requires limited land application. Therefore, whether tougher environmental requirements are imposed under the Animal Agriculture Reform Act, by federal regulation or by state law, land application limits ultimately will be at the heart of those regulations because there is no alternative.

The pork industry also was strongly opposed to the fact that the bill sets a size cutoff for operations subject to the mandatory requirements of the bill. This point raised a complex mix of scientific, economic, and political considerations. It was clear to us while drafting the bill that there is no specific size of operation above which it can be said definitively that there is an environmental threat, and below which no environmental threat exists. The National Pork Producers Association advanced this argument in calling for environmental standards that apply to all commercial producers.

However, there is widespread agreement that the largest animal feeding operations are a priority for regulatory action.^{vii} In the words of the EPA and USDA, Large facilities . . . produce quantities of manure that are a risk to water quality and public health whether the facilities are well managed or not. Because the amount of manure stored is so large, a spill while handling manure or a breach of a storage system can release large quantities of manure and wastewater into the environment causing catastrophic water quality impacts and threatening public health.^{viii}

Furthermore, it seems that making regulations apply to producers of all sizes would impose disproportional compliance costs on smaller producers (particularly capital costs for improved facilities, etc.). The effect of disproportional costs could be to drive out smaller producers already operating at the margin, thereby accelerating the concentration of livestock production onto larger operations.

For these reasons, the Animal Agriculture Reform Act focuses on approximately the largest ten percent of the estimated 450,000 animal feeding operations in the country. It seemed most appropriate, as an equitable matter, to minimize economic impact on smaller operations by providing incentive payments, rather than regulatory mandates, for compliance with the bill's provisions. Therefore, the bill authorizes an additional \$600 million per year for the USDA's Environmental

Quality Incentives Program, with priority funding for smaller livestock producers who prepare manure management plans under the standards set by the bill.

Clearly it is difficult, and probably impossible, to structure environmental regulations in a way that does not affect in some way the economics underpinning the current structure of and trends in the livestock industry. Senator Harkin perhaps said it best when he stated that, "Some issues, like zoning of agricultural enterprises, clearly should be left to state and local governments. Other issues, like the place of the smaller producer in an evolving industry, are complex ones for which there are no easy answers. We should work to guarantee environmental protections regardless of how the structure of the livestock industry changes over time."^x

CONCLUSION

Environmental legislation must reflect credible scientific information or eventually it will become clear that the emperor has no clothes. If a bill's real emphasis is on scoring points with a constituent group -- rather than advancing a serious solution to a real environmental problem -- there may be short-term political gain for the legislator but in the longer term, environmental progress should not be expected (and consequently the legislator also might suffer politically).

While the legislator's obligation is to assess as carefully as possible all scientific information that bears significantly on a legislative issue, scientists also have an obligation to participate in the legislative and political process. They have a responsibility to disseminate information as widely as possible, particularly to legislators and other public

policy decisionmakers. Scientists also have a responsibility to be more politically attuned, to understand what information is needed and is influential in the political process, and to help policymakers translate research results into rational action.

I am not suggesting that science should be increasingly politicized or that research priorities should be determined simply by the shifting political winds. The value of scientific enterprise is greatly diminished if the knowledge it produces is not the basis of public policy. In the case of animal feeding operations and the environment, the future parameters of public policy seem clear; stricter regulation of livestock production with new limits on the land application of manure. The details of that regulation have yet to be hammered out, and that is where scientific input will be critical. What levels of phosphorous in a particular field pose runoff risks? What fertilizer application methods optimize nutrient utilization and minimize runoff? What levels of nitrogen and phosphorous can a given aquatic ecosystem tolerate? The answers that science provides for these kinds of questions will determine the future of the environmental regulation of agriculture.

Disclaimer: This paper reflects the views of the author alone and does not necessarily represent the policies or views of Senator Tom Harkin or any other Member of Congress.

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ENDNOTES

- i.* There may be environmental legislation introduced for wholly non-environmental ends. However, in this paper I am presuming that environmental legislation as an initial matter does address issues generally believed to present environmental problems, however debatable the scope of the problem or the appropriate solutions.
- ii.* U.S. Environmental Protection Agency, Office of Inspector General. Semiannual Report to the Congress, p. 15. May 1997.
- iii.* U.S. Department of Agriculture, Economic Research Service. Water Quality: A Report of Progress, p. 7. Sept. 1997.
- iv.* Remarks of Secretary of Agriculture Dan Glickman prepared for the National Summit on Animal Waste and the Environment, Washington, D.C., May 5, 1998.
- v.* Although the Environmental Protection Agency regulates animal feeding operations under Clean Water Act authority (and the bill does not change that authority), the intent of the bill is to place responsibility for setting nutrient management standards with the agricultural experts at the Department of Agriculture. This has been the subject of debate, but is not addressed here.
- vi.* U.S. Environmental Protection Agency, Office of Inspector General. Semiannual Report to the Congress, p. 16. May 1997.
- vii.* Of course, multiple polluting operations can have a significant water quality impact, regardless of the size of the individual operations. EPA and USDA have agreed that in cases where smaller operations are collectively discharging pollution to an impaired water body or in an impaired watershed, those operations should be brought under a regulatory approach. USDA/EPA Draft Unified National Strategy for Animal Feeding Operations, p. 16, September 11, 1998.
- viii.* USDA/EPA Draft Unified National Strategy for Animal Feeding Operations, pp. 15-16, September 11, 1998.
- ix.* Statement of Senator Tom Harkin, International Conference on Animal Production Systems and the Environment, Des Moines, Iowa, July 20, 1998.