Journal of Agricultural and Applied Economics, 29,1(July 1997):17–36

Induced Policy Innovation: Environmental Compliance Requirements for Dairies in Texas and Florida

Amy Purvis Thurow and John Holt

ABSTRACT

Environmental policies make a difference in shaping producers' choices among dairy production technologies, the sizes and locations of their dairies, and even which dairies ultimately survive. Induced policy innovation means producers reacting to policies, and policies, in turn, being shaped by their effects. Profiles of experiences with environmental compliance in Texas and Florida were analyzed. Results demonstrate that the timing and sequencing of policy signals make a difference in compliance behavior and options. Furthermore, ex ante assessments of the costs of environmental compliance are challenging to carry out, and consequently can undermine the policy goal of maintaining the maximum number of options for compliance.

Key Words: environmental compliance, ex ante policy assessment, induced policy innovation.

Today's animal agriculture technologies span a continuum. Increasingly, livestock and dairy production is industrialized, occurring in specialized facilities tended by specialized labor using routine methods (Rhodes). But there are far more small, family-run farms than "factory" dairies. Which dairy technologies work best where is jointly determined by heritage and past investments; by soils, climate, and landscape; and by the labor and management preferences of individual dairy producers. All 50 states have dairies, and since size and production technology vary in each of them, there are large margins of error around generalizations about environmental policy prescriptions. This paper is about crafting and tailoring policies to manage environmental externalities, specifically from dairies. We are most concerned with policy challenges stemming from heterogeneity within and across states.

In the South's two leading dairy states, Texas and Florida, the intra-state differences in the structure and demographics of dairying are significant. In both states, a growing proportion of milk is produced on large dairies, while several small dairies folded in the 1990s. Thus, Texas and Florida mirror national trends (Fallert, Weimar, and Crawford). The Texas dairy herd expanded by an estimated 73% from 1980 to 1990. During the same period, the Florida dairy herd declined by almost

Amy Purvis Thurow is an assistant professor at Texas A&M University, and John Holt is a professor at the University of Florida.

Research support from the USDA/CREES National Research Initiative (No. 9404099), Winrock International, and Florida Dairy Farmers, Inc. is gratefully acknowledged. Valuable research assistance was provided by Michel Andre, Nicole Elmer, and Kimberly Ludwig. Helpful discussions and comments from Mark Bardolf, Roy Carriker, Art Darling, Michael DeLorenzo, Bud Schwart, Tom Thurow, and Jim Wimberly improved the paper.

19%. New environmental compliance obligations played an important role in the demographic shifts in dairying in both Texas and Florida.

The central premise of this paper is that the design and implementation of environmental policies make a difference in shaping producers' choices among dairy production technologies, the sizes and locations of their dairies, and even which dairies ultimately survive. Producers react to policies, and policies, in turn, are shaped by their effects.

Consensus is emerging among agro-environmental policy professionals about an expanded role for states in crafting and enforcing the policies which frame environmental compliance options and obligations for agricultural producers (Smith; Smith and Kuch; Batie; Ervin and Graffy; Anderson and Hill). Their consensus is based on a hope that environmental compliance policies designed and implemented by states can be flexible and responsive to differences in agro-environmental demographics and in states' preferences for environmental quality. In principle, accommodating heterogeneity at the state level is easier than modifying and stretching 25-year-old federal environmental compliance guidelines to fit conditions and preferences in 50 different states. An expanded role for bottom-up policy initiatives will create opportunities for experimentation and innovation in policy design.

Only California has had longer and more diverse state-level experience in regulating large-scale animal agriculture than Texas and Florida. In both states, confined animal feeding operations (CAFOs)[1] were among the first agricultural producers regulated, and regulation of CAFOs started with dairies. This paper describes lessons learned in Texas and Florida about environmental compliance policies for dairies and, in particular, the economic dilemmas associated with various policy approaches considered or pursued in the two states. We attempt to demonstrate how economic analysis can clarify some of the trade-offs associated with choices among various ways of structuring policies to promote agro-environmental compliance.

In the 1990s, Texas and Florida began revising their environmental compliance policies pertaining to dairies. The problems were (and are) two-fold. First, some dairy producers had already made compliance investments in response to previous policies. Thus, environmental compliance strategies which seemed ideal were often neither practical nor possible. Second, existing dairy manure management policies, even in 1996, are not consistent within either state.[2] Both states still face ongoing challenges in developing equitable policies to accommodate intra-state differences in environmental concerns (for example, groundwater versus surface water protection) and in dairy demographics.

The federal government developed the first policy mandate for regulating emissions from large-scale animal agriculture by requiring National Pollution Discharge Elimination System (NPDES) permits for all CAFOs under the Clean Water Act of 1972.[3] Since the federal Environmental Protection Agency (EPA) does not have sufficient personnel to issue and enforce individual CAFO permits, in 35 states the authority to administer NPDES permits for

[1] In the 1972 Clean Water Act, a confined animal feeding operation (CAFO) was defined as a dairy milking over 700 cows, a swine farm with over 2,500 sows, or a beef feedlot with over 1,000 cattle.

[2] In Texas, all dairies with over 250 cows are permitted by the Texas Natural Resources Conservation Commission, and dairies with over 700 cows maintain a special federal NPDES permit administered by the Environmental Protection Agency. In Florida, all dairies in the Okeechobee basin in south Florida have reconfigured their manure management systems to comply with the 1987 Florida Dairy Rule; a statewide Florida Animal Husbandry Rule pertaining to all dairies with over 70 cows will be promulgated in 1997.

[3] An NPDES permit requires that the CAFO build and maintain sufficient wastewater storage capacity to accommodate a 24-hour, 25-year rainfall event. The permit stipulates a performance standard: no allowable discharges of wastewater (including runoff from a rainfall event) from a CAFO into the waters of the United States. The NPDES permit guidelines also include technical guidelines on how an anaerobic lagoon for holding wastewater and runoff must be built (e.g., the impermeability of clay liners, the recommended capacity of the lagoon) as well as BMPs for applying manure from CAFOs to cropland.

CAFOs has been delegated to state environmental agencies.[4] Florida received delegated authority to administer NPDES permits in 1995, and the EPA issued a special NPDES permit for CAFOs in Texas and four adjoining states in 1994. The EPA critiqued existing NPDES permitting programs in 1993 (U.S. EPA), and the congressional agriculture committees asked for a follow-up study in 1995 [General Accounting Office (GAO)]. The EPA and the GAO both documented that improper manure management is still a problem, despite CAFOs having been regulated for 25 years. Recent EPA statistics indicate that CAFOs are responsible for approximately 26% of the surface water impairments caused by agricultural pollution (Glover). Accordingly, improving the effectiveness of their CAFO permitting procedures is likely to be a priority for state environmental agencies intent on improving their agro-environmental pollution control initiatives. A case in point is the recent experiences in Texas and Florida, where animal agriculture is important and its demographics are changing.

This discussion of environmental compliance on dairies and two states' experiences with induced policy innovation is organized into four sections. First is an overview of environmental policy design principles pertinent to an analysis of compliance options for dairies. The second section profiles the Texas dairy industry and the past decade of environmental regulation to control nonpoint pollution associated with manure management. The centerpiece of this description of the Texas experience is an economic analysis of the feasibility of a centralized composting facility for Erath County, the most important dairy-producing county in Texas, to illustrate the importance of sequencing and timing in successful policy innovation. The third section describes the changing demographics of dairying in Florida, traces the state's recent history of dairy compliance, and chronicles the development of a statewide dairy permitting system in Florida, including an attempted ex ante assessment of its likely economic ramifications. The final section examines the implications from experiences in Texas and Florida, in order to suggest issues and options for other states charged with improving agro-environmental compliance policies pertaining to dairies.

Desirable Characteristics of Environmental Policies

Baumol and Oates showed how and why environmental regulations are most likely to achieve their desired outcomes, particularly over time, if written as performance standards rather than as technical specifications. The flexibility inherent in performance-based environmental regulations encourages technological innovation. Environmental regulations which explicitly or implicitly dictate the use of a particular technology or best management practices (BMPs) dampen incentives to innovate. When implementing technology-based policies, experience shows that it is typical for agro-environmental regulators to issue permits for systems configured in similar ways, using a standard set of BMPs. These compliance strategies are the easiest to evaluate and certify, so innovative producers proposing to do things differently often encounter dissonance and inertia (Purvis and Outlaw).

Boggess pointed out that dynamic considerations are too often ignored in applied policy analysis. When an industry is regulated, it is shortsighted to assume that firms will adopt only tried-and-true technologies. Applied analysis, when constrained to evaluating only known technologies, can limit the scope and development of policy design options. Serious consideration of flexibility-promoting policy options is more likely when analysis also takes account of firms' propensity to seek innovative ways to minimize the costs of compliance. Under regulations which stipulate environmental compliance according to performance

[4] By 1995 estimates, 1,987 of an estimated 6,600 CAFOs in the United States hold permits which satisfy NPDES criteria (GAO). The remainder are either permitted by state environmental regulatory authorities or do not hold permits. Implementation procedures for NPDES permits and the recommended BMPs for applying manure from CAFOs to cropland vary considerably across states (Outlaw et al.).

standards and in a competitive industry, clever firms will seek positive-sum outcomes rather than assume that regulation must be a zero-sum game.

When environmental regulation is designed to promote experimentation, then competition rewards successful innovators. This is known as the Porter hypothesis, which states: Policies mandating strict environmental compliance have potential to make American firms and industries more competitive. As Porter phrased it, "Tough standards trigger innovation and upgrading," with the caveat that "turning environmental concern into competitive advantage demands that we establish the right kind of regulation. . . . They must not constrain the technology used to achieve them, or innovation will be stifled" (p. 168). Porter and van der Linde described case studies where improvements in efficiency—innovation offsets—resulted from investments in environmental compliance.

Porter and van der Linde acknowledged that environmental regulations have not always been successful in promoting innovation, and offered three general guidelines for designing effective policies. First, compliance guidelines should be "phrased as goals that can be met in flexible ways" (p. 110). Regulations ought to be outcome-oriented, encouraging creative thinking on how to change products and processes, rather than locking in the status quo. Using wording which recommends best available control technologies (in agro-environmental policy, BMPs) "almost guarantees that innovation will not occur" (p. 111). Second, regulators can promote innovation by using preemptive standards, placing the burden of proof on firms themselves to demonstrate how they will achieve environmental protection. Firms are encouraged to develop their own compliance strategies to achieve the mandated environmental goals. Perhaps most importantly, the compliance process is improved when forums are available for settling regulatory issues without litigation. Improving the two-way flow of information between firms and regulators is likely to help both achieve their desired outcomes. Finally, efforts to coordinate and harmonize environmental regulations issued at different levels of government can reduce uncertainty and improve innovation. Uncertainty impedes compliance, particularly if the uncertainty is due to policy variables which are exogenous to the firm's span of control. If firms know what is expected of them, and when, then important barriers to investment are removed. Conversely, during periods when the time line for compliance is uncertain, or if compliance guidelines are a moving target, then compliance investments lag. Policy uncertainty was an impediment to compliance investments in environmentally sound technologies among Texas dairy producers in the early 1990s (Purvis et al.).

Environmental economists have accused Porter and van der Linde of oversimplifying the complex task of designing and implementing environmental regulation (see Palmer, Oates, and Portney). For example, the Porter hypothesis influenced the federal Environmental Protection Agency's policy rhetoric in the 1990s. The EPA sought win-win environmental policies, eschewing the "somewhat reactive focus on trade-offs in favor of a more proactive focus on ways to achieve environmental protection and economic progress at the same time" (Gardiner, p. 20). Environmental economists bristled. Questioning whether "we can avoid painful choices when setting environmental goals and instead 'have it all,'" Portney asserted, "That's simply not true and we had better recognize this admittedly unpleasant reality if we are to fashion wise economic and environmental policies" (p. 22).

With appropriate caveats, the Porter and van der Linde guidelines are helpful in framing discussions about improving state-level environmental policies. Palmer, Oates, and Portney improved the workability of these guidelines by debunking the notion that environmental compliance pays for itself through innovation offsets, an inappropriate generalization which has been drawn from the Porter hypothesis. In sum, Palmer, Oates, and Portney acknowledged four points of agreement with the Porter hypothesis. First, incentive-based regulation is better than command-and-

control.[5] Second, ex ante estimates of compliance costs often ignore technological innovation, and thus are inflated. Third, most firms could indeed improve their efficiency through adopting either cost-saving or quality-improving technologies, and the obligation to comply with environmental regulations forces firms to explore such options. Finally, an important role for regulators is to disseminate information about ways to improve compliance. Thus, the Porter hypothesis, enriched by its critics, offers a useful conceptual starting place for states endeavoring to improve their agro-environmental policies.

Dairying and Environmental Compliance in Texas

Texas dairying demographics shifted in the 1990s. In the early 1980s, several dairy producers from Arizona, California, and the Netherlands emigrated to Erath County in central Texas (Kilborn). Stephenville is the county seat, and within a 50-mile radius of Stephenville there are an estimated 70,000 cows (Gerlin). Erath County has 179 dairies (Fleming), including 35 dairies with more than 700 cows per dairy. The largest Texas dairy producer milked 4,700 cows in 1993, and plans further expansion (Robinson). Hopkins County, 200 miles away and dominated by small-scale dairies, produced more milk than Erath County until 1992. From 1991 to 1996, Hopkins County lost 36% of its producers (the number of dairies dropped from 539 to 344). Hopkins producers still outnumber Erath producers by two to one, but Erath County now produces twice as much milk as Hopkins County (Fleming). In 1996, total milk production for Erath County increased by 2%, while it decreased by 7% in Hopkins County (Fleming).

Environmental Compliance for Large Dairies in Central Texas

In principle, Texas CAFO producers were expected to maintain a federally mandated NPDES permit since 1972, but these permits were administered by the EPA, not the Texas Water Commission. Beginning in 1987, the Texas Water Commission required permits for new dairies with over 250 cows. Established dairies with over 250 cows are required to apply for a permit if they expand their facilities. Dairies established before 1987 are grandfathered: dairies with over 700 cows are expected to comply with NPDES guidelines, but other large dairies (with 251 to 699 cows) need not petition for a separate Texas permit. The key feature of Texas water permits for dairies is a no-discharge requirement modeled after the NPDES permit. In addition, the Texas permit includes guidelines for wastewater containment and manure spreading (Sweeten, Baird, and Manning).

In Erath County, Texas, 1992 spring rainfall was well above average. Though there was never a 24-hour, 25-year flood event, 34 dairy lagoons spilled effluent into adjacent streams and rivers after several consecutive days of rainfall (McFarland, McFarland, and Sweeten). The Texas Sierra Club threatened to file a citizen's lawsuit against the discharging dairies. The lawsuit was never filed, but in July 1992, the EPA's Region VI office in Dallas proposed a special permit to impose more stringent manure management guidelines and to harmonize federal and state pollution prevention requirements for CAFOs. The special NPDES permit, pertaining to Texas and four adjacent states, was finalized in February 1994. To comply, producers must maintain de-

[5] Paying the costs of hiring, training, and retaining qualified scientists is an important and growing problem for environmental regulatory agencies, particularly at the state level. In the meantime, there is a high cost associated with encouraging regulatory staff members to be creative and flexible when they write permits. If their judgment misses subtleties or scientifically substantive issues, then the agency issues flawed permits. This sort of implementation problem sends confusing signals to the regulated community and, inadvertently, can contribute to long-run pollution problems. Command-and-control regulations are appealing, therefore, because of reliability, coherence, and built-in checks and balances. Incentive-based and performance-based environmental regulations have some superior attributes, but comprehensive economic analyses of regulatory designs of these more flexible policies must include the estimated costs and required personnel for the monitoring and adaptive management needed to support such regulatory design.

tailed records of their manure management practices, including rates of manure spreading on cropland, soil testing, and groundwater monitoring. A standardized format for these mandatory Pollution Prevention Plans (PPPs) was developed by the Texas Association of Dairymen. No routine reporting on PPPs is required, but dairy managers must produce their PPP records if a regulatory question arises. Some producers have hired an additional employee or a consultant to maintain their PPPs. However, ongoing environmental compliance—in particular, permitting and public hearings, or when a problem arises—usually requires the time and attention of the primary manager of a dairy.

In Texas during the early 1990s, a series of public hearings was routinely required for any siting of new dairy facilities or expansion of existing facilities, to satisfy neighbors and regulators that the technical requirements had been met. The only Texas producer siting a new 400-cow dairy in 1992 negotiated with neighbors in a dozen public hearings, spending over $100,000 in legal fees and two years in the process (Stalcup). In December 1993, a dairy producer willing to meet and exceed (more than double) all the technical requirements specified by all three required permits was denied the opportunity to build a new 2,020-cow dairy due to opposition from his neighbors (Holan). Delays in permitting and unclear precedents regarding the interpretation of permit guidelines deterred dairies' efforts to reconfigure their manure management systems or expand their dairies (Pagano et al.). Improvements and innovation were stymied. To address these concerns and streamline the permitting process, an amended set of guidelines for public hearings and permit applications was promulgated by the Texas Natural Resources Conservation Commission (TNRCC) in 1995 (Texas Administrative Code, Chapter 321, subchapters B and K). These new guidelines also consolidated the requirements for Texas air and water quality permits for CAFOs.

In principle, for dairies with over 700 cows, standards required by the special NPDES permit and the Texas consolidated permit for air and water quality are now fully harmonized as of June 1995,[6] and enforcement protocols are established. In 1993, the TNRCC implemented its Dairy Outreach Program (Foster). Inspectors from the TNRCC visited all dairies in Erath County, small and large, and assessed their dairy manure management practices. Reports documented a larger proportion of inadequate BMPs and localized water quality problems associated with small dairies than from large dairies. As a follow-up, the TNRCC recently stationed a full-time inspector in Stephenville who is responsible for implementing a routine monitoring program for Erath County dairies. Producers applaud routine monitoring because those in compliance can officially document their improvement efforts, and bad actors get caught.

Establishing and implementing compliance standards for smaller dairies is an ongoing regulatory challenge because the manure management systems on smaller dairies were grandfathered under the recent permitting changes, and many cannot afford new investments. Frarey, Jones, and Pratt have proposed cost-sharing and technical assistance to improve manure management and assure that environmental protection standards are being met by dairies with less than 700 cows. Harmonizing environmental compliance standards for manure management on both large and small dairies is unfinished business for Texas agro-environmental regulators.

Composting as a Policy Option for Texas Dairies

Composting dairy manure is attractive as a pollution prevention strategy (Sims). Biochemically, composted manure is more stable than raw manure because the nitrogen in composted manure is converted to a form which is plant-available but not as mobile in runoff

[6] In 1993, the Texas Water Commission and the Texas Air Control Board were merged into the Texas Natural Resources Conservation Commission (TNRCC). Prior to June 1995, dairy producers in Texas with more than 700 cows were expected to meet three differing sets of permit standards: an NPDES permit, a water permit from the Texas Water Commission, and an air permit issued by the Texas Air Control Board.

or groundwater. Also, composted manure has less odor than raw manure.

Everywhere, policies to improve the profitability and feasibility of composting have been an environmental Holy Grail. Near the beginning of the decade-long process of designing and implementing environmental compliance guidelines for the dairy industry, Texas policy analysts recognized a role for coordination if composting were to be a feasible policy alternative. In particular, a centralized compost processing facility would have allowed Erath County to take advantage of economies of size in manure handling and compost marketing (Masud et al.). As environmental compliance requirements were ratcheted up during the early 1990s, the cluster[7] of dairy producers in Erath County and adjacent counties sought minimum-cost, environmentally sound options for managing dairy manure. Producers made fixed capital investments in land and technologies for managing manure as fertilizer and wrote these technologies into their NPDES and Texas permits. Given a side-by-side comparison of the farm-level economics of their current systems and of composting, some may well have installed composting technologies, given the requisite policy incentives. Without a basis for assessing farm-level economic trade-offs associated with composting compared with alternative manure-handling technologies, and without policy coordination, composting technologies were not adopted by Erath producers.

The timing and sequencing of policy signals make a difference in compliance behavior and options. Though composting was once a promising manure management option for producers, the irony is that in 1995 (when regulators got serious about composting as a policy option because it seemed to offer a win-win compliance strategy), the window of opportunity had closed for most Texas dairies to incorporate composting into their manure management systems.

Prospects for Composting

An estimated 175,000 tons of manure per year are produced by the cluster of dairies located within a 50-mile radius of Stephenville, Texas (Gerlin). Most of the dairy manure in Erath County is used as fertilizer; solid manure is plowed into the soil, and liquid wastewater is applied to cropland through an irrigation system on most large-scale dairies. During several months of the year when no crops are growing, more manure is produced than can be applied to cropland at rates which can be utilized by agronomic crops (Purvis and Outlaw). Furthermore, many large-scale dairies find that buying feed is more economical than growing crops.

In 1992, five dairy producers formed the Erath Fertilizer Products Cooperative to organize those interested in working together on composting dairy manure (Lancaster). They favored a centralized composting facility which would both process and market the composted manure. Concurrently, the City of Stephenville actively explored solid waste management options including systems for composting dairy manure with municipal wastes such as lawn clippings. During the period 1992 to 1995, the TNRCC was actively promoting composting as a way for small Texas cities to handle part of their waste streams and thus cope with constraints on landfill space (TNRCC). Regulations on composting facilities, promulgated by the TNRCC, were tailored to issues facing municipalities rather than building in the flexibility to accommodate handling agricultural by-products as well. Ultimately, the city abandoned the idea of organizing a multi-function composting facility as part of its long-range solid waste management plan because it could neither satisfy the TNRCC's technical requirements, nor raise the start-up capital, nor provide the logistical support to initiate a waste management system in-

[7] Clustering in animal agriculture occurs due to advantages from the economies of size in importing feed commodities and in supporting a specialized service sector, such as veterinarians and equipment repairs, required to support large-scale dairying (Thurow). The downside of clustering is that environmental externalities often get worse over time as existing firms get larger in response to economies of size and as greater numbers of production and processing facilities move into the localized region.

volving composting of dairy manure.[8] At the same time, dairy producers were preoccupied with understanding and responding to an evolving labyrinth of dairy compliance rules. Stymied by regulators' indecision and producers' indifference, the Erath Fertilizer Products Cooperative disbanded.

After implementing new environmental permit requirements in 1994 and 1995, Texas and regional agro-environmental regulators appreciated how much the dairy industry had paid for compliance—in both economic and nonpecuniary ways. Furthermore, the zeal of composting advocates is contagious, and the potential for composting as a win-win compliance option appealed as a way to heal recent wounds. In late 1994, the EPA commissioned Winrock International to study the feasibility of composting livestock manures in Texas, building on lessons learned in Arkansas on the development of a market for composted poultry litter (Govindasamy and Cochran; Harsch). In conjunction with the Winrock study, Outlaw, Purvis, and Miller analyzed the economic costs of composting on a representative large dairy (1,000 cows) and a representative small dairy (250 cows) in Erath County.

Typical small dairies own the equipment required to haul and spread solid manure, and the cropland on small dairies is generally more than sufficient to handle all the manure produced. Only a small proportion of manure nutrients is managed as wastewater. On a representative small dairy in Erath County, the net economic benefits from managing manure (in particular, increased forage production and improved forage quality) outweigh the costs by an estimated $10.23 per cow.

In contrast, typical large dairies in central Texas are unlikely to own sufficient cropland acreage to handle all the manure they produce. Accordingly, a significant capital cost associated with manure management is leasing or purchasing cropland for manure spreading.[9] Typically, large-scale dairies contract with specialized haulers to spread their solid manure, and a large proportion of their manure nutrients is applied to cropland through irrigation systems. Given these practices, and despite economies of size, manure handling costs more than it pays. On a representative large dairy in Erath County, the net economic costs of managing manure exceed the benefits by an estimated $13.57 per cow. A large share of these costs is represented by the sunk costs associated with leasing or purchasing enough cropland to manage manure nutrients in compliance with recently implemented environmental regulations.

Obstacles to Composting as a Policy Innovation

Improving small-scale Texas dairies' manure management is arguably the most pressing issue facing Texas agro-environmental regulators. Most small-scale dairies have adequate land for manure spreading, but many cannot handle all their runoff from storm events, and others do not have proper manure storage facilities for seasons when cropland is dormant. Texas needs to devise incentive-compatible policies to motivate producers with less than 250 cows to manage the environmental externalities associated with nutrients from dairy manure. However, composting would not benefit these small Erath County dairies, because they value manure as fertilizer. Accordingly, a policy promoting composting would harm rather than help most small-scale Texas dairy producers. On the other hand, large-scale producers agree that a composting facility might

[8] The City of Stephenville subsequently signed a long-term contract with a commercial firm which will implement a curbside residential recycling program. The contract includes no provisions for handling dairy manure or other agricultural by-products.

[9] To qualify for a Texas consolidated air/water permit, dairies with over 250 cows must demonstrate that they have sufficient cropland to handle the nutrients from manure applied at agronomic rates. To satisfy permitting requirements, in the early 1990s, many Erath County dairy producers purchased additional cropland or entered into long-term leasing agreements with their neighbors. Nutrient management requirements for Texas dairies (as in other states, with the notable exception of the Okeechobee watersheds in Florida) are based on agronomic standards for nitrogen rather than phosphorus.

be a cost-effective and advantageous way to transport manure nutrients off dairies. But as one large producer noted, "The idea of providing off-farm manure disposal alternatives is three to six years too late for most of us" (Outlaw, Purvis, and Miller, p. 13).

Given compliance options and costs as of 1996, large-scale producers have three problems with becoming partners in a centralized composting scheme.[10] First and most important, for several the window of opportunity has closed. To dispose of their manure, these producers have bought additional cropland or entered into long-term lease agreements with their neighbors. Applying manure nutrients at agronomic rates is an important criterion for permit approval. Now, an inspector routinely monitors whether manure nutrients are applied at agronomic rates. Maintaining the PPPs associated with an NPDES permit requires having enough cropland to handle nutrients from the dairy's manure. Without a dependable plan for manure management, producers are out of compliance. A dairy relying on a composting facility to transport its manure off the dairy would risk being out of compliance if the facility were unable to accept its manure. Once large-scale dairies have made an investment in sufficient cropland, any other plan for handling manure would be less dependable. Reliability has intangible, but significant, value.

Second, there is the chicken-and-egg dilemma associated with getting a centralized composting facility operational. To be feasible, a centralized composting facility requires large volumes of manure. Thus, several producers must promise to supply their manure for composting—but none will agree until effective demand for the final product is assured. Yet for the facility to develop a market for compost, it needs to be able to demonstrate the availability of a steady supply of high-quality compost. Because of these interrelationships, it is virtually impossible to simultaneously develop a market for compost and guarantee a reliable supply of manure to produce the compost.

The third issue is profitability. Given the fits, starts, and jerks that have accompanied a composting start-up in the area, some large-scale producers in Erath County would require both a long-term contract and a profit-sharing clause in any contract to supply their manure to a composting facility. Such requirements could undermine the economies of size needed to justify a centralized composting facility, and would exacerbate the chicken-and-egg dilemma.

In summary, if contracting to supply manure to a centralized composting facility had been a viable option in the early 1990s, it is likely that several large-scale producers would have worked hard to make such a facility a success. Although some agro-environmental regulators remain optimistic about composting as a policy option, pragmatic constraints exist for both small-scale and large-scale producers. Timing matters in policy implementation. So do the profitability and feasibility of the technology. Without policy intervention, the coordination sufficient to assure the success of a centralized composting facility seems unlikely.

Dairying and Environmental Compliance in Florida

Florida's milk price is consistently the highest in the U.S. (Babb). Even so, some combination of high production costs, regulatory concerns, and a strong land market has caused a steady decline in dairy farm numbers in recent decades. Total milk production peaked in

[10] Under certain circumstances, the economics of composting on-farm are compelling (Rynk et al.; Dreyfus), in lieu of linking with a centralized composting facility. In particular, where new dairies are locating near large metropolitan areas with demonstrated effective demand for composted dairy manure, or in regions where seasonal manure application is truncated by weather, then on-farm composting is particularly alluring. But for large-scale Erath producers, the notion of making further investments to compost on-farm—in management, labor, and equipment—is not appealing. In addition, existing sunk investments associated with land application of manure, and permits written accordingly, preclude their serious consideration of the on-farm composting option. Furthermore, effective demand for composted dairy manure in central Texas is neither proven nor reliable. Individual producers have a sense of the magnitude of the costs and time associated with developing such a market.

1994, dropped 9.2% in 1995, and lost another 0.2% in 1996. In 1970, there were 451 dairies averaging 426 cows per farm. By 1996, there were about 250 dairies, with an average herd size of more than 600 cows. This average masks diversity: Okeechobee County, with an average herd size of more than 1,400 cows, has almost three times as many dairy cows as any other county, but almost one-third of them (more than 10,000 cows) are owned by one family operation. About 60 dairies in the state milk less than 200 cows. In Okeechobee and adjoining counties, phosphorus runoff in surface water is the primary environmental concern. In the northern part of the state, where most dairies are smaller than the state average, nitrate leaching into groundwater is the major nonpoint pollution threat from dairies.

Environmental Compliance for Dairies in South Florida

In 1971, the governor called a conference on water management in south Florida. A 1976 report, synthesizing the results of this conference and subsequent studies, identified Lake Okeechobee as the bellwether for south Florida water quality problems and implicated phosphorus runoff from high-density pastures and inadequate dairy manure management as contributing to degraded water quality in Lake Okeechobee (Boggess, Flaig, and Fonyo). In 1978, dairy producers in the Okeechobee region were offered state-funded cost-sharing to fence riparian areas, and a water quality monitoring program was initiated. In 1981, Okeechobee dairy producers were eligible for additional federal cost-sharing funds to implement BMPs (fencing riparian areas, shade structures, filter strips) in conjunction with the Rural Clean Water Program (Stanley).

In the mid-1980s, environmentalists increased pressure to clean up Lake Okeechobee, expressing "fear that the lake is dying because of blooming algae, which strips the water of life-giving oxygen and thereby threatens fish and wildlife and possibly, they say, the entire Everglades ecosystem as well" (Hersch, p. 30).[11] The Florida Dairy Rule, a state regulation pertaining only to Okeechobee dairies (49 dairies, approximately 45,000 cows), was issued in 1987 (Boggess, Flaig, and Fonyo). The Dairy Rule was implemented by the Florida Department of Environmental Regulation (FDER),[12] and producers had until 1989 to respond. To comply, producers could install specified manure management technologies which contained all surface water runoff from the high-intensity areas on their dairies, or cease operating in the Okeechobee basin. In part due to uncertainty about effectiveness of the technologies, the legislature made cost-sharing available to dairies investing in compliance technologies. Those dairy producers not electing to comply received $602 per cow if they ceased operating. Eighteen dairies (14,039 cows) exited the industry.

The average annualized cost associated with Dairy Rule modifications was estimated at $0.97 per hundredweight (cwt) of milk produced, and the total cost of implementing the regulations, from 1987 to 1993, was estimated at $63,734,402 (Johns). Total cost-sharing by the state to dairies was approximately $12 million, dairies themselves paid approximately $5 million for mandatory modifications, and dairy producers spent an additional $23.3 million on optional modifications plus an additional $3.6 million in increased costs of dairy operation and maintenance. Water quality monitoring and administrative expenses associated with implementing the rule were approximately $8.6 million. Carrying out the buy-out program cost an estimated $11.2 million.

In their investigation of the economic impact of the Dairy Rule on Okeechobee dairies, Boggess, Holt, and Smithwick reported that because small and large dairies in Okeechobee

[11] Relationships which link water quality in Lake Okeechobee and the Everglades ecosystem are complex, and, though much has been learned, the role of phosphorus in surface water runoff from dairies is incompletely understood. (For more information, refer to Light, Gunderson, and Holling.)

[12] In 1993, the Florida Department of Environmental Regulation was renamed the Florida Department of Environmental Protection (FDEP).

responded differently to the Dairy Rule, compliance had different results. In their study, the researchers profiled 14 small dairies that averaged 768 cows, and 11 large dairies that had 1,409 cows on average. Conventional wisdom says that early adopters of new technology benefit most—but not in this case. Small dairies averaged 12.6 months of construction time; large dairies, whose managers waited, watched, and learned, took 9.6 months on average to complete construction. A phenomenon only partially explained by economies of size, "construction-related decreases in milk production cost large dairies an average of $253/cow and small dairies an average of $438/cow. In sum, it appears that despite almost identical investment costs per cow for the FDER components, the Dairy Rule will ultimately cost small dairies roughly 50% more per cow than it does large dairies" (Boggess, Holt, and Smithwick, pp. 16–17).

In addition to mandatory investments, a subset of the large dairies also elected to install production-enhancing technologies, such as shades and sprinkler systems, which were unrelated to environmental compliance. These investments are somewhat different than the innovation offsets touted by Porter and van der Linde. Savvy managers elected to make these nonmandatory investments concurrent with compliance investments only because the normal production activities on their dairies were already being disrupted by construction. These managers allocated extra resources and hired engineers to design systems which improved on the FDER engineering plans written into the Dairy Rule. In addition to containing all runoff, their systems were designed to improve cow comfort. For example, cows tend to congregate under shades to keep cool; thus a large proportion of their manure can be handled efficiently in flushed systems which are easily installed in concrete alleys under newly built shades. Only because the optional shades were part of the cooling system designed into the late-adopters' modified facilities was it cost-effective to collect manure in a flushed system. Therefore, though milk production improved on some large dairies after the installation of their Dairy Rule-induced modifications, only a portion of their increased milk yields can be attributed to the mandatory phosphorus runoff-abating technologies. Okeechobee dairies' milk production was not enhanced, nor were costs reduced, by the mandated compliance technologies. Those who benefitted did so by investing in production-enhancing technologies (which were not cost-shared) not associated with phosphorus runoff reduction. Thus, these were not "innovation offsets" as described by Porter.

Okeechobee County and the neighboring rural communities were set back by the implementation of the Dairy Rule (Clouser et al.; Hersch). Clouser and his co-authors estimated that closing a 1,000-cow dairy meant losing about $2.3 million in milk sales, which cost the area $3.7 million in indirect sales, 36 full-time equivalent jobs, and more than $600,000 in earnings. Eighteen dairies elected to close, which cost the area about $50 million in countywide sales, 500 jobs, and $9 million in earnings. *Florida Trend* is the leading business magazine in the state, and its cover story in January 1993 dramatized the loss of about 30% of the local economy's base. The final sentence in that widely disseminated story emphasized wide-ranging and long-run consequences triggered by environmental regulation: "If there are lessons from Okeechobee's dairy farms, one of them may well be this: the cost of a cleaner environment goes far beyond those who are most immediately affected" (Hersch, p. 35).

Florida has five water management districts that wield huge power and have unusual wherewithal to monitor and study localized water quality issues. They have taxing authority, and both write and enforce water management regulations. Under intense political scrutiny for its role in the Okeechobee area, the South Florida Water Management District (SFWMD) commissioned a comprehensive follow-up study by a consulting company (Johns). Presently, the SFWMD is planning to make cost-sharing available to dairies and beef cattle ranches for additional voluntary investments in new technologies and BMPs to reduce phosphorus runoff in the Lake Okeechobee watersheds.

Leveling the Compliance Playing Field in Florida

With rules in place about controlling phosphorus runoff in the Lake Okeechobee watershed, concerns shifted statewide regarding manure management on dairies and other CAFOs. A study by the U.S. Geological Survey in the early 1990s (Andrews) found higher-than-normal levels of nitrates in groundwater near dairies in the Suwanee River basin. Accordingly, in 1994, the Florida Department of Environmental Protection (FDEP) began the process of crafting a statewide rule. Its first target is dairy and poultry operations in the Suwanee River basin. In 1995, the FDEP received delegated authority to issue NPDES permits; thus, when permits are issued under the new Florida Animal Husbandry Rule (FAHR), they will satisfy both state and federal environmental compliance requirements.

Lessons learned in Okeechobee regarding political economy, plus policy design principles consistent with the Porter hypothesis, seem to have prompted innovation in the statewide CAFO rule-writing process in at least four ways. First, prior to releasing its statewide rules, the FDEP established a 20-member Dairy Waste Management Technical Advisory Committee which includes university extension and research scientists, dairy producers, consulting engineers, other state agency personnel, and representatives from grass-roots environmental action coalitions and wildlife organizations. That committee held public meetings to hear comments on two drafts of the rules. When the FAHR is finalized in 1997, all dairies with 200 or more cows will be required to qualify for a permit. For dairies having between 70 and 200 cows, permits will be required for those operations judged to be a significant threat to surface or ground water quality. Dairies with fewer than 70 cows only need a permit if they cause a documented water quality violation. There will be a five-year phase-in period, beginning in 1998, with the smallest dairies having the longest time to comply. Dairies unwilling to install the prescribed manure management systems and associated BMPs have the option of instead carrying out and paying for groundwater monitoring, thereby accepting the burden of proof to demonstrate that no nutrients from their facility are contaminating groundwater.

Second, the staff at FDEP, in conjunction with its Technical Advisory Committee, is committed to writing a policy which is as general as possible, emphasizing performance standards rather than delineating (thus indirectly recommending) particular technologies or BMPs. Those charged with writing the FAHR have heard bitter complaints from dairy producers about the limited workability and flexibility implicit in the technology-based guidelines spelled out in the initial version of the Florida Dairy Rule for Okeechobee.[13] Furthermore, experience with issuing permits outside the Okeechobee region on an ad hoc basis has taught them that case-by-case evaluation of permit applications is expensive, time consuming, and often criticized by both producers and other stakeholders.

A third, and related, policy design principle embraced by those involved with the FAHR is the importance of enforcement. In conjunction with the performance standards written into the statewide CAFO rule, the FDEP intends to release a checklist of items which will be monitored routinely on permitted facilities. Instead of specifying how producers should design systems to comply, the FDEP is attempting to articulate how their performance will be judged. The agency is working with the Florida Department of Agriculture and Consumer Services to assure that trained personnel will be assigned to carry out routine monitoring of permitted CAFOs.

Finally, both the FDEP and dairy producers are enamored with the notion of ex ante as-

[13] Among the core staff of FDEP charged to design and implement the FAHR, none were involved in crafting or implementing the Florida Dairy Rule. This lack of an institutional memory hobbles efforts to learn from past failures and successes in policy design and implementation. Short institutional memories plague all state environmental regulatory agencies. Well-qualified personnel either leave state government to pursue more lucrative careers as environmental consultants or move up in the organization to positions where they are no longer on the front lines, carrying out day-to-day decisions about policy design or enforcement.

sessment of the consequences of implementing new environmental regulations. In 1996, the Florida legislature mandated that before any new regulation could be passed, a statement of its "estimated regulatory cost" must be presented and approved in a public hearing (Florida Administrative Code, Chapter 120.54). Two Ph.D. economists on the FDEP staff will develop an estimate of the prospective economic effects associated with the FAHR, as well as all other new regulations promulgated by the FDEP.[14] In addition, Florida Dairy Farmers, Inc., a statewide cooperative, was pleased with what it learned about the costs of compliance with the Florida Dairy Rule from two studies it paid for with check-off funds (Boggess, Holt, and Smithwick; Clouser et al.) and with the repercussions from its spin-offs (Hersch; Johns). Producers recognized, however, that conducting economic analysis after a regulation is in place and they have already responded (i.e., postmortem) restricts the opportunities for innovation and for adjustment of the policy to reduce the financial pain and attrition triggered by compliance. Accordingly, they commissioned economists at the University of Florida to follow and analyze the proposed FAHR before it became policy.

Armed with good intentions, agricultural economists set out to do an ex ante evaluation of the forthcoming rules. Funded in 1994, the study had three objectives: (*a*) establish production costs for representative dairies, statewide; (*b*) simulate pre-rule returns for those dairies, estimate the cost of compliance with the new regulations, simulate post-rule dairy returns, and hence estimate dairy survival rates and lost statewide milk incomes; and (*c*) complete an input-output study to get estimates of the statewide economic impact of the new rules on dairies.

The first objective was completed in 1996 with data developed in collaboration with panels of producers in three distinct production regions in Florida (Holt et al.), but the other two objectives were not. The year 1995 was an economic disaster for dairymen, during which Florida milk production dropped more than 9%. Milk price improved markedly in 1996, but feed cost increases ate most of that milk price increase, and statewide milk production still fell slightly. Given the shambles 1995 made of dairy producers' balance sheets, even with heroic confidence in the power of simulation modeling, how would one establish which dairies went out of business as a result of the new rules rather than because of economic conditions? Absent a cause-and-effect analysis—which could only realistically be conducted *after* the fallout—it made little sense to complete the input-output study.

Selling the study was easy; getting data was not. Due to the demographics of dairying in north Florida, the study focused on smaller dairies, which typically have more environmental compliance problems than newer, larger operations. Knowing them to be inadequate, small dairy producers were loath to document their current manure management practices, even in a forum where their anonymity is protected. Moreover, lacking collateral for routine borrowing, it required an impossible stretch of the imagination for producers to describe what they might do if they were forced to comply with new environmental regulations. It is likely that such hypothetical economic data would be wrought with bias.

Getting cost estimates for compliance is stickier than one thinks, ex ante. Where does one find engineering estimates for satisfactory compliance with as-yet unwritten rules? Academic engineers are reluctant to provide them, fearing being cast as originators of harsher BMPs than the regulators might otherwise promulgate. Consulting engineers would provide designs, but want specifications and their consulting fees paid up-front. Regulators, having been burned by charges of arbitrariness in the Okeechobee experience, are understandably reluctant to release preliminary guidelines. On some level, regulators also appreciate that providing guidelines would defeat the purposes of writing a general and performance-oriented policy. In short, "let sleeping dogs lie" attitudes prevail on the part of all parties when it actually comes down to getting the data re-

[14] In 1995, the FDEP finished developing and finalized approximately 100 new rules.

quired for ex ante impact studies of new regulations.

Conclusions and Implications

Texas and Florida have spent a fair share of the past decade toiling in the flat section of a steep learning curve. Learning is a by-product of induced policy innovation, whereby regulators send a policy signal, producers respond, and subsequent policy signals are conditioned both by how producers respond and by concurrent or previous actions taken in response to other policy signals. We offer two generalizations as a summary of the salient lessons from Texas and Florida. Then we venture three ideas about which direction is forward. We conclude with ideas about how applied economists might best contribute to the induced policy innovation process facing animal agriculture in the coming years.

The Limitations of Ex Ante Economic Assessments of Policy Proposals

It is easy to underestimate the difficulty of conducting ex ante estimates of the costs of environmental compliance.[15] Producers in Florida who suspected that their manure management practices might be deficient were reluctant to document existing practices. Designs and costs of systems to satisfy flexible compliance standards are practically unavailable, ex ante. It undermines the policy goal of maintaining the maximum possible number of options for compliance to make the assumptions needed to conduct an ex ante economic analysis. In addition to the challenges of getting the necessary data, it is difficult to separate the effects associated with regulatory impacts from those caused by normal economic ebbs and flows.

The Okeechobee experience made everyone involved appreciate the importance of conducting an ex ante assessment. Producers, regulators, and analysts were committed to learning as much as possible about the economic repercussions of proposed environmental regulations *before* they are promulgated and enforced—thus before it is too late. The draft proposals for the Florida Animal Husbandry Rule (FAHR) are consistent with the spirit of the Porter hypothesis, written broadly to encourage innovative compliance investments rather than to constrain the technological options considered by producers. Ironically, however, flexibility in the design of the rule—which keeps options open for producers and allows regulators to apply common sense as they implement the policy—hobbled economists' efforts to conduct an ex ante assessment of the likely costs associated with compliance.

This is not to say that ex ante assessment of technology adoption behavior is impossible. Ex ante analysis of compliance behavior was successfully modeled by Purvis et al. That study considered a well-defined group of large-scale Texas dairy producers and their decision making about investing in a well-defined technology—free stall dairy barns. The policy lesson learned was that Texas producers' propensity to postpone investments in free stall barns was increased due to uncertainty about performance guidelines, the lack of a specific time frame for compliance, and dissonance in signals from state and federal regulators.

Linkages and Sequencing Make a Difference

So obvious that it is often overlooked, our second conclusion is that today's policy options are conditioned by what already happened and what is already in place. As discussed above, Florida analysts, producers, and regulators were agreed about the importance of conducting an ex ante economic assessment of new environmental regulations because of a shared understanding which emerged from their experiences with the Florida Dairy Rule and its aftershocks. Yet, due to sequencing problems,

[15] Some of the same issues discussed here are likely to rear their ugly heads if a federal policy is passed which requires an ex ante economic assessment of any new regulation, such as the bill proposed in the 104th Congress. State policies requiring ex ante economic estimates of "takings" of private property due to implementation of new regulations will pose similar difficulties.

these two policy design goals seem mutually exclusive.

Similarly, in central Texas, the window of opportunity for composting closed for three reasons associated with linkages and sequencing: (*a*) because it was not framed as a viable option when producers made now-sunk investments in their current manure management technologies, (*b*) because it would have been necessary to design compliance guidelines to encourage composting as an option, and (*c*) because policy coordination and incentives were lacking but necessary (for example, to motivate the City of Stephenville and the dairy industry to make decisions in tandem, to establish market channels for composted dairy manure, and to get a centralized composting facility off the ground).

These examples from Texas and Florida illustrate the importance and complexity of policy sequencing and linkages at the state level. It gets exponentially more complicated when intertwined local/state/federal policy linkages are considered. Though increasing state jurisdiction over environmental compliance for CAFOs is already happening, it is no panacea. Policy choices taken by states are independent neither of federal precedents nor of the combination of political will and economic wherewithal necessary for policy enforcement and fine-tuning at the local level. Accordingly, for the future, it is relevant to consider the role of linkages and sequencing in structuring the federal/state/local collaboration needed to accomplish successful policy innovation.

Physical Heterogeneity Poses a Dilemma

Even within states, the environmental externalities associated with CAFOs vary according to costs of production, soils, climate, and landscapes. A justification for increasing the states' roles and jurisdiction in policy design is to accommodate such heterogeneity. Sometimes, as in both Texas and Florida, it is asking too much for a regulatory agency to develop and implement a one-size-fits-all rule to fit an entire state. Passing responsibility to states for policy fine-tuning does not necessarily solve the problem of leveling the proverbial playing field.

Consider the policy sequencing and linkages associated with deciding whether to continue using nitrogen-based agronomic requirements for crops in manure management regulations or whether to acknowledge the ecological importance of phosphorus and modify manure management regulations accordingly. In Florida, as in other states, it is soils rather than pollution abatement practices that make nitrates leaching into groundwater the key environmental problem in one part of a state (such as in north Florida), whereas phosphorus in surface water runoff is the most compelling pollution problem in another place (such as in south Florida). Scientists have known for decades that phosphorus is the primary limiting nutrient in the ecological resiliency and stability of many agronomic systems, particularly in places with a long history of crop production and animal agriculture (Shapley et al.). The farm press and extension educators have begun disseminating the scientific facts about paying attention to the soil's ability to store phosphorus and agronomic crops' ability to use phosphorus in choosing manure application rates (Cubbage; Lanyon; Shapley).

Most state-level regulators appreciate that agronomic guidelines for land-applying manure nutrients from dairies and other CAFOs might eventually consider the phosphorus requirements of crops, as well as agronomic guidelines for nitrogen uptake. A few have started the process of changing their policies. The ramifications are nontrivial. Under a phosphorus-based policy regime for CAFOs, for example, composting will become cost-effective on some dairies and in some regions where it never was before. Old and established CAFOs, and particularly small farms, will need more cropland. Some cropland historically fertilized using manure is already an environmental hazard. Accordingly, some CAFOs will be put out of business unless economic incentives are offered to ease the transition. Without cost-sharing, it would be difficult to get rid of manure-spreading guidelines based on nitrogen-based agronomic

requirements of crops. Such a change would involve overturning previously established state policies developed in accord with the federal NPDES permit.

Heterogeneity in Size and Structure Is Perplexing

There is a persistent double standard and a long history associated with the question of whether small or large producers are responsible for the most glaring agro-environmental problems. In animal agriculture—beginning with the federal NPDES permit promulgated in 1972—large-scale producers are held to a higher standard of environmental protection than is expected of small-scale producers. A maintained assumption in the NPDES permit is that large CAFOs pollute more than small-scale dairy and livestock operations, but, to date, there is insufficient scientific evidence and very little field-level data to refute or support this claim (Smith; Smith and Kuch; Thurow; GAO).

Most large-scale CAFOs have made significant investments to improve their manure handling, and many have been made accountable to control pollution. In contrast, small-scale CAFOs are not regulated in many states. The economies of size associated with dairy manure management technologies are well established (Matulich, Carman, and Carter; Thurow). There are similar economies of size in dairy production technologies (Congress of the U.S., Office of Technology Assessment). Smith argued forcefully that the policy decision to offer cost-sharing to small, traditional farms may mean keeping leaky boats afloat, and we need to know more about the relative magnitude of the environmental problems and the costs of controlling them for small and large animal agriculture producers in order to make sound policy choices based on facts.

Nostalgia about "family farms" and traditional agriculture—a persistent feature in federal policy discussions and an obstacle to factual discussions regarding policies with differential effects on small and large farms—is even more likely to be a feature on state and local political landscapes. The investments and expectations associated with small-scale agriculture have a long history and heritage. Viewpoints are divided about concentration and industrialization, particularly in animal agriculture (see Padberg). Accordingly, it is naive to expect that state policy design can accommodate and resolve the difficult issues associated with transitions from small-scale to industrialized animal agriculture, particularly when federal policies never could. "Selective decentralization" informed by science-based guidelines, as proposed by Smith and Kuch (pp. 1248–49), is a more workable approach to induced policy innovation for animal agriculture than unconstrained and uncoordinated federalism.

Fundamentally, All Politics Are Local

Margaret Mead cautioned to "never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has" (p. 1). Grass-roots initiatives can affect federal legal precedents regarding CAFOs and, accordingly, alter policy. Consider Dick Popps, a New York dairy producer who was sued in *Southview Farms v. Concerned Area Residents for the Environment.*[16] The rural residents who sued their neighbor filed the lawsuit on grounds of water pollution (Merrill 1993). Originally, a local jury decided the case in favor of the dairy farmer because they were not convinced that dairy effluent was responsible for alleged groundwater and surface water pollution, but in an appeal, that ruling was overturned (Merrill 1995). Popps and the New York farm or-

[16] The Southview case is significant because it signals an abrupt shift in thinking about the scope and boundaries of large-scale animal agriculture's environmental protection responsibilities. Since the 1972 Clean Water Act was passed, large-scale CAFOs have been required to handle surface water runoff under a zero-discharge permit modeled after the point-source requirements enforced for industrial producers. The Southview ruling extends the pollution prevention responsibilities of dairy producers and other CAFO operators significantly. According to the final court opinion issued, spreading manure from a CAFO on cropland is now considered point-source pollution; thus it falls under the purview of the NPDES permit.

ganizations supporting him spent $600,000 in legal fees (Roenfedt). The U.S. Supreme Court declined to hear Popps' appeal (Martin).

It is too soon to say how *Southview Farms v. C.A.R.E.* ultimately will affect CAFO policies, and it will be the unfolding of future legal precedents (to the extent that nuisance disputes continue to be settled in the courtroom) that will shape the ultimate outcomes. In the meantime, uncertainty is exacerbated for large-scale producers. As long as the federal NPDES permit is the cornerstone of federal and state CAFO policies, neighbors and grassroots environmental activists have legal standing to sue, or can threaten to sue, large-scale dairy producers to contest their environmental management practices. Even if the 105th Congress reauthorizes the Clean Water Act (also a goal for the five previous Congresses), federal legal precedents associated with the NPDES permit will not go away. Thus, the future will continue to be shaped by the past. Furthermore, local government and front-line enforcement of regulations are likely to play a greater role in shaping future environmental policy than state environmental regulatory agencies.

Hope for the Future

Improved communication improves regulation. Florida's experience with the 1987 Dairy Rule increased the propensity to communicate, as evidenced in how the FAHR is being crafted. Producers funded an ex ante study; regulators formed a broadly based technical advisory committee and conducted hearings before promulgating the rules, and interagency cooperation will be a keystone of the enforcement plan. An extension task force in Florida (Carriker) is utilizing the collective strength of several agencies, county extension agents, dairy producers, and industry representatives to develop training workshops for agency personnel who must implement the regulations. Dialogues between regulators and extension personnel have already led to important two-way learning. Currently, regulators claim that they wrote specific guidelines into existing agro-environmental regulations because producers asked to know exactly what constitutes compliance. As a result, regulators were hamstrung: the rigidity in the regulations restricted their leeway to apply common sense in implementing and interpreting regulations.

In Texas, Florida, and elsewhere, extension engineers and agronomists have played leadership roles in the iterative and ongoing policy deliberations about the design of BMPs and nutrient management planning procedures for livestock producers (Purvis and Abdalla). Economists have led cross-disciplinary teams who offer assistance with community-level conflict management involving CAFOs and other nuisance cases at the rural-urban fringe (Abdalla and Kelsey). County extension agents—supported by information and analysis from extension economists—have important and constructive roles to play in agro-environmental policy innovation (Thurow).

To date, perhaps the most innovative extension leadership has emerged at the county level, where agents have been pragmatists, diplomats, and educators. Noteworthy examples include Joe Pope, the county agent in Erath County, Texas; Russ Giesey in central Florida; Judith Wright, the county agent in Cayuga County, New York (Wright); and Bill Thompson, the county agent in Chaves County, New Mexico. County extension agents, with linkages to their Land-Grant colleagues, are well positioned as translators and conveyors of information. Both research and extension economists could do more to support county extension agents' efforts, and thus improve the Land-Grant system's ability to educate all the stakeholders in agro-environmental policy.

References

Abdalla, C.W., and T.W. Kelsey. "Breaking the Impasse: Helping Communities Cope with Change at the Rural-Urban Interface." *J. Soil and Water Conserv.* 51,6(November-December 1996):462–66.

Anderson, T.L., and P.J. Hill. "Environmental Federalism: Thinking Smaller." Issue No. PS-8, PERC Policy Series, Political Economy Research Center, Bozeman MT, 1996.

Andrews, W.J. "Reconnaissance of Water Quality at Nine Dairy Farms in North Florida, 1990–91." USGS Water Resources Investigations Rep. No. 92-4058, U.S. Geological Survey, Denver CO, 1992.

Babb, E.M. "Future of Dairy Marketing Order." Staff Pap. No. 363, Food and Resour. Econ. Dept., University of Florida, 1996.

Batie, S.S. "Future Environmental Policy: The State Role." Paper presented at Symposium on the Influence of Social Trends on Agricultural Natural Resources, Washington DC, 21 May–2 June 1995.

Baumol, W.J., and W.E. Oates. *The Theory of Environmental Policy,* 2nd ed. New York: Cambridge University Press, 1988.

Boggess, W.G. "The Poverty of Applied Policy Analysis." *J. Agr. and Appl. Econ.* 27,1(1995): 1–12.

Boggess, W.G., E.G. Flaig, and C.M. Fonyo. "Florida's Experience with Managing Nonpoint Source Phosphorus Runoff into Lake Okeechobee." In *The Management of Nonpoint Source Pollution,* eds., C. Russell and J. Shogren. Dordrecht, The Netherlands: Kluwer Press, 1993.

Boggess, W.G., J. Holt, and R.P. Smithwick. "The Economic Impact of the Dairy Rule on Dairies in the Lake Okeechobee Drainage Basin." Staff Pap. No. 91-39, Food and Resour. Econ. Dept., University of Florida, 1991.

Carriker, R.R. "The FL-115 Design Team on Florida's Regulatory Environment." Unpub. memorandum, Institute for Food and Agricultural Sciences, Coop. Ext. Ser., Gainesville FL, 1996.

Clouser, R.L., D. Mulkey, W.G. Boggess, and J. Holt. "The Economic Impact of Regulatory Decisions in the Dairy Industry: A Case Study in Okeechobee County, Florida." *J. Dairy Sci.* 77(1994):325–32.

Congress of the U.S., Office of Technology Assessment. "U.S. Dairy at a Crossroad: Biotechnology and Policy Choices." Special Rep. No. OTA-F-470. Washington DC: U.S. Government Printing Office, May 1991.

Cubbage, S. "Look Out for Phosphorus." *Dairy Herd Management* 31(September 1994):42–48.

Dreyfus, D. "Feasibility of On-Farm Composting." Pub. No. RRC/RU-90/2, Rodale Research Center, Emmaus PA, 1990.

Ervin, D.E., and E.A. Graffy. "Leaner Environmental Policies for Agriculture." *Choices* (4th Quarter 1996):27–33.

Fallert, R., M. Weimar, and T. Crawford. "Here's Why Milk's Moving West." *Hoard's Dairyman,* 10 January 1994, pp. 34–35.

Fleming, R. "The Market Administrator's Report: Texas Marketing Area." Office of the Milk Market Administrator, Carrollton TX, December 1996.

Foster, S. "Program Finds Dairies Complying—Mostly." *Stephenville* [Texas] *Empire-Tribune,* 17 February 1993.

Frarey, L.C., R. Jones, and S.J. Pratt. "Planned Intervention: Merging Voluntary CAFO Pollution Abatement with Command-and-Control Regulation." In *Balancing Animal Production and the Environment.* Great Plains Pub. No. 151. Denver CO: National Cattlemen's Association, 1994.

Gardiner, D. "Does Economic Policy Conflict with Economic Growth?" *Resources* 115(1994):19–21.

General Accounting Office. "Animal Agriculture: Information on Waste Management and Water Quality Issues." Briefing Rep. No. GAO/RCED-95-200BR to the Committee on Agriculture, Nutrition, and Forestry, U.S. Senate, Washington DC, 1995.

Gerlin, A. "As the State's Milk Production Increases, So Do the Screams of Environmentalists." *Wall Street Journal,* 25 May 1994, p. T1.

Glover, T. "Livestock Manure: Foe or Fertilizer?" In *Agricultural Outlook.* USDA/Economic Research Service, Washington DC, June 1996.

Govindasamy, R., and M.J. Cochran. "The Feasibility of Poultry Litter Transportation from Environmentally Sensitive Areas to Delta Row Crop Production." *Agr. and Resour. Econ. Rev.* 24,1(April 1995):101–10.

Harsch, J. "Poultry Litter Marketing and Utilization Project: A Case Study, 1992–1995." Unpub. rep., Winrock International, Petit John Mountain AR, 1995.

Hersch, V. "The Price of Clean Water." *Florida Trend* (January 1993):30–35.

Holan, M. "Tuls Dairy Permit Denied: Third Denial This Year Comes Despite Environmental Plans." *Stephenville* [Texas] *Empire-Tribune,* 17 December 1993.

Holt, J., M. Andre, M. Sowerby, D. Solger, C. Vann, and K. Ludwig. "Estimated 1995 Dairying Costs and Returns in Three Florida Areas." Staff Pap. No. 96-14, Food and Resour. Econ. Dept., University of Florida, November 1993.

Johns, G.M. "Report to the South Florida Water Management District: Analysis of Economic Impacts, Water Quality Programs, Lake Okeechobee Watershed." Hazen and Sawyer, Envi-

ronmental Engineers and Scientists, Hollywood FL, 27 March 1995.

Kilborn, P.T. "Dutch Settlers Start Boom in Texas Dairy." *New York Times,* 16 July 1995.

Lancaster, B. "Co-op Would Market Manure: First-Ever Enterprise Seen Aiding Dairies." *Stephenville* [Texas] *Empire-Tribune,* 29 October 1992.

Lanyon, L.E. "A Nutrient Management Approach for Pennsylvania: Nutrient Management Decision Making." Agronomy Fact Sheet No. 38-C, Coop. Ext. Ser., College of Agricultural Sciences, Penn State University. Undated.

Light, S.S., L.H. Gunderson, and C.S. Holling. "The Everglades: Evolution of Management in a Turbulent Ecosystem." In *Barriers and Bridges to the Renewal of Ecosystems and Institutions,* eds., L.H. Gunderson, C.S. Holling, and S.S. Light. New York: Columbia University Press, 1995.

Martin, J.H. "*C.A.R.E. v. Southview Farms:* A Review." In *Animal Agriculture and the Environment: Nutrients, Pathogens, and Community Relations.* Pub. No. NRAES-96. Ithaca NY: Northeast Regional Agricultural Engineering Service, 1996.

Masud, S., R. Lacewell, R. Schwart, G. Allen, and A. Lovell. "Feasibility of Large-Scale Alternatives for Dairy Waste Recycling and Treatment: Erath County Region of Texas." Project report to the Texas Soil and Water Conservation Board. Texas Agr. Ext. Ser., College Station, 1991.

Matulich, S.C., H.F. Carman, and H.O. Carter. "Cost-Size Relationships for Large-Scale Dairies with Emphasis on Waste Management." Giannini Foundation Res. Rep. No. 324, California Agr. Exp. Sta., Berkeley, October 1977.

McFarland, M.J., A.M.S. McFarland, and J.M. Sweeten. "Comparison of Daily and Event Precipitation Totals for the Hydrologic Design of Animal Waste Treatment Systems." In *Balancing Animal Production and the Environment.* Great Plains Pub. No. 151. Denver CO: National Cattlemen's Association, 1994.

Mead, M. *Tapa from Tonya in the South Pacific.* Honolulu HI: Anuenue Press, 1991.

Merrill, L.S. "New York Manure Case Reversal Raises Regulatory Concerns." *Hoard's Dairyman,* 10 January 1995, p. 9.

———. "No Clear Winners in Southview Farm Manure Suit." *Hoard's Dairyman,* 25 August 1993, pp. 618–19.

Outlaw, J., A. Purvis, and J. Miller. "An Evaluation of Dairy Manure Management Economics." Res. Rep. No. 95-2, Agricultural and Food Policy Center, Texas A&M University, 1995.

Outlaw, J.L., R.B. Schwart, Jr., R.D. Knutson, A.P. Pagano, A. Gray, and J.W. Miller. "Impacts of Dairy Waste Management Regulations." Work. Pap. No. 93-4, Agricultural and Food Policy Center, Texas A&M University, May 1993.

Padberg, D.I. "Concentration in Agriculture: A Report of the USDA Advisory Committee on Agricultural Concentration." USDA/Agricultural Marketing Service, Washington DC, 1996.

Pagano, A.P., K. Sims, J. Holt, W. Boggess, and C. Moss. "Environmental Permitting and Technological Innovation." In *Balancing Animal Production and the Environment.* Great Plains Pub. No. 151. Denver CO: National Cattlemen's Association, 1994.

Palmer, K., W.E. Oates, and P.R. Portney. "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?" *J. Econ. Perspectives* 9,4(1995):119–32.

Porter, M.E. "America's Green Strategy." *Scientific American* (April 1991):168.

Porter, M.E., and C. van der Linde. "Towards a New Conception of the Environment-Competitiveness Relationship." *J. Econ. Perspectives* 9,4(1995):97–118.

Portney, P.R. "Does Economic Policy Conflict with Economic Growth?" *Resources* 115(1994):21–23.

Purvis, A., and C.W. Abdalla. "Analyzing Manure Management Policy: Toward Improved Communication and Cross-Disciplinary Research." In *Animal Waste and the Land-Water Interface,* ed., K. Steele. Boca Raton FL: Lewis Publishers, 1995.

Purvis, A., W.G. Boggess, C.B. Moss, and J. Holt. "Technology Adoption Decisions Under Irreversibility and Uncertainty: An Ex Ante Approach." *Amer. J. Agr. Econ.* 77,3(1995):243–50.

Purvis, A., and J.L. Outlaw. "What We Know About Technological Innovation to Achieve Environmental Compliance: Policy Issues for an Industrializing Animal Agriculture." *Amer. J. Agr. Econ.* 77,5(1995):1237–43.

Rhodes, V.J. "The Industrialization of Hog Production." *Rev. Agr. Econ.* 17(1995):107–18.

Robinson, S. "The Biggest Dairy in Texas." *The Dairyman* (October 1993):8–10, 57.

Roenfedt, S. "Save Money Now." *Dairy Herd Management* 32,8(August 1995):26–28.

Rynk, R., M. van de Kamp, G.B. Wilson, M.E. Singley, T.L. Richard, J.J. Kolega, F.R. Gouin, L. Laliberty, D. Kay, D.W. Murphy, H.A.J. Hoi-

tink, and W.F. Brinton. *On-Farm Composting Handbook.* Pub. No. NRAES-54. Ithaca NY: Northeast Regional Agricultural Engineering Service, 1992.

Shapley, A.N. "Myths About Phosphorus." In *Animal Agriculture and the Environment: Nutrients, Pathogens, and Community Relations.* Pub. No. NRAES-96. Ithaca NY: Northeast Regional Agricultural Engineering Service, 1996.

Shapley, A.N., S.C. Chapra, R. Wedepohl, J.T. Sims, T.C. Daniel, and K.R. Reddy. "Managing Agricultural Phosphorus for Protection of Surface Waters: Issues and Options." *J. Environ. Quality* 23(1994):437–51.

Sims, J.T. "Characteristics of Animal Wastes and Waste-Amended Soils: An Overview of the Agricultural and Environmental Issues." In *Animal Waste and the Land-Water Interface,* ed., K. Steele. Boca Raton FL: Lewis Publishers, 1995.

Smith, K.R. "Environmental Issues from an Economic Perspective." In *Increasing Understanding of Public Problems and Policies—1994,* eds., S.A. Halbrook and T.E. Grace, pp. 119–26. Oak Brook IL: Farm Foundation, 1995.

Smith, K.R., and P. Kuch. "What Do We Know About Opportunities for Intergovernmental Institutional Innovation? Policy Issues for an Industrializing Animal Agriculture." *Amer. J. Agr. Econ.* 77,5(1995):1244–49.

Stalcup, L. "Big Stick in Texas." *Dairy Today* (August 1992):8–10.

Stanley, J.W. "The Key to Successful Farmer Participation in Florida's Rural Clean Water Program." In *Ten Years of Controlling Agricultural Nonpoint Source Pollution: The RCWP Experience.* Seminar Publication, EPA/625/R-92/006. U.S. Environmental Protection Agency, Office of Research and Development, Office of Water, Washington DC, August 1992.

Sweeten, J., C. Baird, and L. Manning. "Animal Waste Management." Rep. No. L-5043, Texas Agr. Ext. Ser., College Station, September 1991.

Texas Natural Resource Conservation Commission. *Texas Municipal Compost Marketing Manual.* Austin TX: TNRCC Office of Pollution Prevention and Recycling, 1994.

Thurow, A. "An Industrializing Animal Agriculture: Challenges and Opportunities Associated with Clustering." In *Privatization of Technology and Information Transfer in U.S. Agriculture: Research and Policy Implications,* ed., S. Wolf. Ankeny IA: Soil and Water Conservation Society (in press, 1997).

U.S. Environmental Protection Agency (EPA). "The Report of the EPA/State Feedlot Working Group." EPA, Office of Wastewater Enforcement and Compliance, Washington DC, September 1993.

Wright, J.L. "Agriculture and Water Quality in Central New York's Finger Lake Region: Regulatory versus Voluntary Programs." In *Animal Waste and the Land-Water Interface,* ed., K. Steele. Boca Raton FL: Lewis Publishers, 1995.