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Environmental Policy and Technology Adoption
in Animal Agriculture

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Structural changes in the swine and dairy industries, combined with well-publicized incidents of discharges from manure storage facilities into surface water, have refocused attention on environmental and nuisance concerns arising from the concentration of animals increasingly common in the livestock sector. Intense debates on how to address such concerns are being conducted in a policy environment characterized by a growing interest in more flexible environmental policy tools. The question of whether flexible incentives will successfully respond to environmental concerns in animal agriculture is best answered by asking, instead, whether we can get there from here. That is, can incremental changes in current policies for animal agriculture take advantage of the opportunities afforded by flexible policies, or are more comprehensive changes needed?

This paper addresses these questions by first describing the animal agriculture industry, focusing on the growing concentrations of large, intensive livestock operations. Second, the concerns about environmental impacts of concentrated animal production are presented, followed by a review of the economic concepts which underlie these concerns and the potential for environmental problems. To set the stage for a discussion of flexible incentives and animal agriculture, the current policy setting is described, including a discussion of environmental policies implemented at national, state, and local levels to address concerns related to animal production.

The Agricultural Setting

Animal agriculture is industrializing. This industrialization is characterized by fewer farms, with more animals on less land, producing an increasing share of the meat, milk, and eggs supplied to American consumers. Economies of size in both production and processing technologies are an important force driving industrialization. In production, industrialization means specialized facilities

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tended by specialized labor using routine methods (Rhodes 1995). Historically in the United States, farms produced both crops and livestock. Family labor availability capped the size of production facilities. Family members did whatever was most urgent, from milking cows to baling hay or spreading manure. In contrast, large industrialized facilities tend to emphasize animal husbandry and procure feedstuffs rather than grow their own crops. As animal numbers increase, production cost advantages arising from specialization and the routinization of tasks often increase exponentially. In regions where state regulatory agencies or local zoning authorities require compliance with environmental protection laws, large-scale industrialized operations often hire consultants and/or specialized employees trained to maintain records and supervise manure handling.

In addition to economies of size in production, vertical coordination in processing and marketing is an important impetus for industrialization. Industrialized firms often enter contracts with producers to guarantee a predictable supply of carcasses for their meat processing facilities and to assure the quality of their final consumer products. Vertically coordinated firms procure feed and provide veterinary services for their contract producers, thereby capturing economies of size from the agglomeration of functions.

Clustering in an animal agriculture arises from large-scale production facilities locating in close proximity to processing facilities (Thurow 1997, Pagano and Abdalla 1994). Key economic determinants of clustering are vertical coordination driven by consumer preferences for quality (Barkema, Drabenstott, and Welch 1991) and related economies of size in production technologies, manure management technologies, meat-packing technologies, and coordination associated with contractual relationships between producers and processors. Clustering is a cumulative phenomenon. The establishment of a processing facility draws increasing numbers of large-scale producers. Once sited, producers tend to adopt production and manure-management technologies to achieve improvements in economies of size, adding animals to generate revenue to pay for such technological improvements.

Environmental Problems in Animal Agriculture

Negative environmental externalities associated with clustering are often significant. Threats of pollution and nuisance damages tend to compound over time as the density of livestock in the

region increases. Over the course of a year, the quantity of nitrogen in manure generated from a 200-cow dairy is the same as sewage from a community of 5,000 to 10,000 people; the phosphorus from a 22,000-bird broiler house matches the quantity produced in sewage from a town of 6,000 people (Moffitt 1995). Production units larger than 200 cows or 22,000 broilers are common to industrialized clusters. In addition to water quality concerns from improper manure handling, odor and flies are often problematic on large livestock production facilities (Van Horn 1995, Thu 1995).

Locational shifts associated with industrialization in animal agriculture have been rapid and region-specific. From 1982 to 1992, the hog inventory in North Carolina grew by 109% (Moffitt 1995), whereas Iowa lost 10,482 hog farms with less than 100 head (USDA). From 1982 to 1992 the New Mexico dairy sector expanded by 62% (Moffitt 1995), whereas New Hampshire lost 10,766 dairy farms with under 100 head (USDA). Before 1950, poultry production was evenly distributed across the United States as a backyard enterprise in the counties surrounding metropolitan areas, but by 1971 it was concentrated in the South (Martin and Zering 1997, Reimund *et al.* 1981). From 1984 to 1994 broiler production increased by 65% in the United States (Moffitt 1995).

According to the most recent statistics from the U.S. Environmental Protection Agency (EPA), concentrated animal feeding operations (CAFOs)[2] are responsible for approximately 26% of the surface water impairments caused by agricultural pollution (Glover 1996). The EPA relies on reports and monitoring data from state environmental agencies to develop their estimates of pollution contributions by sector and by region (see US EPA 1992). The 1972 Clean Water Act regulated CAFOs as point-source polluters and livestock production facilities with less than 1000 animal units as nonpoint source polluters.[3] In some national- and state-level assessments of the contributions of animal agriculture to water quality problems, it is not clear whether assessments describe point source or nonpoint source pollution potential, or both. A distinction between point and nonpoint source

[2]In the 1972 Clean Water Act, a concentrated animal feeding operation (CAFO) was defined as a 1000 animal-unit facility, in particular a dairy milking over 700 cows, a swine farm with over 2500 sows, or a beef feedlot with over 1000 cattle.

[3] In some cases, depending upon how discharges emanate from smaller operations (a function of manure and stormwater management), operations with less than 1000 animal units may be designated as CAFOs.

discharges from animal agriculture is key to clarifying how animal operations will be treated under existing or modified water quality policy and standards. Generally speaking, point sources are held to a higher standard of protection than are nonpoint sources. In animal agriculture, those operations labeled point sources are regulated while those labeled nonpoint sources are not.

Letson and Gollehon (1996) analyzed data from the 1992 Census of Agriculture to develop a national profile to delineate where animal agriculture is concentrated and, accordingly, to identify where nutrients from manure are or could be applied to cropland as an organic fertilizer. They identified high-priority regions and clusters and concluded that policies targeting specialized animal production are needed to protect water quality from pollution. Mass balance studies of the handling of nutrients from manure and feedstuffs conducted at the farmstead, watershed, and county level can further inform and refine the design of policy instruments targeting water quality protection (Lemberg *et al.* 1992, Lanyon 1992, Boggess *et al.* 1993, Smolen *et al.* 1994).

Existing data and analyses of the scope and locations of pollution threats from animal agriculture have focused on surface water impairments from nutrient runoff and, to a lesser extent, leaching of nutrients into groundwater. Nuisance damages associated with odor and flies or public health risks from pathogens are less well understood, more location specific, and more difficult to measure and monitor. Yet nuisance complaints figure prominently in localized conflicts surrounding the siting and on-going coexistence of livestock production facilities and their neighbors. Neighbors are often as concerned or more concerned about odor, flies and pathogens from livestock facilities than they are about the potential impacts on water quality.

In public policy, issues associated with animal agriculture, industrialization, and environmental quality are inextricably linked. In the past 20 years, a disturbingly predictable pattern of negative environmental externalities and community-level outrage accompanying this clustering phenomenon has repeated itself in several states where clusters of poultry, dairy and swine producers and processors have become established (Pagano and Abdalla 1994, Smith and Kuch 1995, Thurow 1997). New entrants are attracted by the positive economic dynamics of a well-established cluster and its allied agribusinesses, and greater production volume from existing production facilities and new entrants triggers expansions in processing capacity. The collective economic power of a cluster of livestock producers and processors is buttressed by this self-reinforcing pattern of growth. Voices

of protest against clustering, industrialization, and negative environmental externalities associated with clustering are often squelched, even as the potential for pollution and nuisance damages gets worse.

Economics of Livestock and the Environment

Economic theory offers three primary explanations for the conflicts observed in animal agriculture. Each addresses how incentives to invest in environmental protection technologies may differ for large-scale, intensive livestock producers as compared to smaller, more traditional producers.

Cumulative externalities. Manure handling and industrialized production processes have the potential to cause negative environmental externalities and other unwanted changes in rural communities related to industrialization. Both externalities and changes in community dynamics are cumulative. Local institutional capacity is often inadequate to handle conflicts which arise due to political economy. At the same time, state and federal policy instruments are often ineffective in handling local policy problems, given the heterogeneity in physical features, climate and land-use preferences,. The scope of externalities and conflicts which can arise with livestock clusters may be best addressed with coordinated policies implemented at multiple levels, with federal, state, and local linkages. However, inherent to the choice of where to place policy responsibilities for manure management in animal agriculture is a tradeoff between the desire to create a level playing field for producers across regions and the need to provide sufficient flexibility so that local preferences can be articulated in the policy design (Thurow and Holt 1997).

Technology adoption. Reliance on stewardship ethics and volunteerism is unlikely to yield a sufficient level of investment in manure management technologies as animal agriculture industrializes. Adoption of environmental technologies to meet compliance obligations is fundamentally different from adoption of production-enhancing technologies (see Purvis and Outlaw 1995). There is no evidence that innovation offsets[4] from investments in improved nutrient

[4]Porter and van der Linde (1995) have described as innovation offsets those technologies which improve efficiency although they are adopted for environmental compliance. When environmental regulation is designed to promote experimentation, it is more likely that some

management and manure handling technologies exist in livestock production. A large proportion of the costs associated with adoption of compliance technologies is the cost of capital investment (thus sunk costs) required. No immediate pay-offs (increased cash flow) arise to reward adoption and help to offset investment costs, except avoiding possible costs from fines or lawsuits if regulations are enforced. Unlike crop production, where the use of a new pesticide or nutrient management technology may be a one-season decision, animal agriculture often requires a large capital component in manure management technologies, the costs (or benefits) of which will carry over several years.

The distribution of costs and benefits of environmental technology adoption is also problematic. A case in point is the availability of feed additives which can reduce the level of phosphorus in swine manure. Using such feeds could be expected to reduce phosphorus management costs for growers. However, in cases of production contracting where feeds are supplied by integrators who bear no responsibility for manure management, there is no incentive for the integrators to pay for the feed additive.

Jointness of production and manure management technologies. Economies of size in manure management technologies have received considerable attention for the hog sector (Roka, Hoag and Zering 1995; Martin and Zering 1997) and for the dairy sector (Matulich *et al.* 1977, Boggess, Holt and Smithwick 1991, OTA 1991, Leatham *et al.* 1992, Lovell *et al*. 1992, Outlaw 1993). There is jointness between production technologies and manure management technologies (Matulich 1978). Conventional wisdom says that pollution-averting technologies are not scale neutral and that, generally speaking, large-scale facilities will have lower per-unit costs. This assertion holds **except** for land-constrained facilities or clusters where environmental regulations are being enforced (Martin and Zering 1997).

If environmental externalities associated with improper manure management are likely to occur when animal numbers per facility exceed some threshold number, then theoretically production cost curves are U-shaped. Economies of size mean per unit production costs decline as animal numbers increase, until external costs begin to arise and per unit costs rise accordingly. Sustainable agriculture advocates believe that under a policy regime forcing CAFOs to internalize their

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innovators will make changes which allow them to meet environmental quality goals **and** improve competitiveness (Thurow and Holt 1997).

environmental costs, land-extensive farms integrating crop and livestock operations would have significant cost advantages. For state-of-the-art manure handling technologies in dairy and swine, current data and knowledge are insufficient (too anecdotal) to establish or disprove the U-shaped cost curve hypothesis. The only empirical work to support the hypothesis was done by Matulich (1978) for California dairies 20 years ago.

Without reliable information about size/scale economies, there are convoluted discussions about policy objectives. Some have alleged that small livestock farms with older technology are "leaky boats" -- potentially presenting significant environmental risks, while newer, larger farms have the resources to adopt modern, more environmentally-protective technology. The policy question which arises from this debate is whether we want to design policies which keep leaky boats afloat? Or do small-scale facilities look like leaky boats because of current regulations (Smith 1995)?

Environmental Policy for Animal Agriculture

The federal policy role. Federal regulation of large-scale animal agriculture started with the Clean Water Act (CWA) of 1972, which mandated that all CAFOs maintain National Pollutant Discharge Elimination System (NPDES) permits. 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) are allowed from a CAFO into the waters of the United States. Federal NPDES permit guidelines also specify design criteria for anaerobic lagoons to hold wastewater and runoff -- the impermeability of clay liners, the recommended capacity of the lagoon -- as well as criteria for best management practices for applying manure from CAFOs to cropland.

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 CAFOs has been delegated to state environmental agencies. Implementation procedures for NPDES permits and the guidelines for applying manure to cropland vary considerably across states (Outlaw *et al.* 1993, GAO 1995). The EPA critiqued existing NPDES permitting programs in 1993 (EPA), and the Congressional agriculture committees requested a follow-up study by the General Accounting Office in 1995 (GAO). This study estimated that 1,987 of an estimated 6,600 CAFOs

in the United States held federally-administered NPDES permits (GAO, 1995). The remainder of CAFOs are either permitted by state environmental regulatory authorities or do not hold permits.

The re-authorized Coastal Zone Management Act (Coastal Zone Act Reauthorization Amendments - CZARA) focuses on nonpoint discharges in the twenty-nine coastal and Great Lakes states. Each of those states is required to define its coastal zone area. CZARA contains considerably tighter controls for nonpoint sources than those in the nonpoint section (section 308) of the Clean Water Act. Livestock operations with more than 50 animal units are regulated under CZARA, although the law requires individual states to develop specific guidelines for controlling such nonpoint sources and enforcing regulations (Morse 1993).

Under the 1996 Federal Agriculture Improvement and Reform (FAIR) Act, one-half of Environmental Quality Incentives Program (EQIP) funds are earmarked for manure management by livestock operations. A key design issue for program implementation has been whether large-scale facilities will be eligible to receive federal cost-sharing to comply with regulations with which they are already obligated to comply under the CWA. As authorized by FAIR, the EQIP program was developed to help farmers and ranchers address environmental impacts of agriculture. However, cost-share assistance to "large" livestock operations was forbidden; USDA was charged with defining large. USDA has determined that, as a baseline, operations which have fewer than the 1000 animal units (the Clean Water Act point source designation) will be eligible for EQIP funds. However, the final rule provides states with some flexibility -- the NRCS State Conservationist, in cooperation with the State's EQIP Technical Advisory Committee, can develop state-level criteria for defining large (USDA, NRCS). Critics have charged that such state discretion creates the possibility for 50 different interpretations of large, with livestock operations treated differently by different states with respect to their eligibility for EQIP funds, and may permit taxpayer dollars to help corporate farms build pollution controls that the CWA already obliges them to install. Ferd Hoefner, of the Sustainable Agriculture Coalition, as quoted in a Washington Post article, expressed concern that, depending upon actions taken by individual states, EQIP could require "U.S. taxpayers to bribe large-scale polluters to obey the law (Wallace Institute 1996)."

The state policy role. The trend of placing more responsibility for regulating animal agriculture with the states is important. States always had the authority to write and enforce rules

more stringent than the NPDES permit and to regulate smaller operations, with federal guidelines a minimum standard. Some states are choosing to hold animal agriculture to environmental standards higher than those in the federal law. Other states are seeking a balance between environmental protection and a growing animal agriculture industry, with the expectation that animal agriculture may contribute to rural economic revitalization.

In general, however, states have dealt with questions related to livestock facilities through such varied statutory measures as corporate farming laws and right-to-farm laws. Corporate farming laws (actually anti-corporate farming) are intended to protect the competitive position of small to mid-size, family-owned and operated farms from entry of large, corporate operations. Corporate farming laws may serve to limit the size of livestock operations but do not address siting or management of small-to-moderate sized operations.

Right-to-farm laws deal less with the size of a livestock operation and tend, instead, to address conflicts between livestock farms and neighboring land uses. Right-to-farm laws exist in all states and serve to protect farming operations -- both crop and livestock, small and large -- from nuisance complaints lodged by neighbors. Michigan provides an example of how some states have broadened the role of right-to-farm laws to encompass environmental protection objectives by making nuisance protection dependent upon farmers' use of "generally accepted agricultural management practices." Right-to-farm laws may impact management of livestock operations of all sizes but do not address the siting of new operations or expansion of existing operations and the potential neighbor-to-neighbor conflicts that such changes may introduce.

The local policy role. Siting of livestock operations is clearly a land use issue, and, traditionally, land use has been viewed as a local issue to be addressed through exercise of local planning and zoning authority. Given their experience at guiding specific land uses within their jurisdictions to sites which minimize conflicts between incompatible uses, local governments clearly have a comparative advantage in addressing the local impacts of CAFOs. However, not all states which have rural zoning laws have experienced widespread adoption of rural zoning by local governments. Local communities in states like TX, OK and FL have resisted adoption of rural zoning. Such communities are often ill-equipped to deal with siting questions, and, in some states, local governments have pressed for a state-level policy response to address siting.

In those areas where rural zoning is used, local governments have begun to modify zoning ordinances to guide, or in come cases restrict, the siting of livestock operations. Zoning approaches have ranged from simply permitting such operations by right, to permitting by right subject to site suitability or management conditions, to requiring operations to apply for special use permits, the application for which requires compliance with specific restrictions or conditions. Where local governments have chosen to exercise zoning authority to restrict management of new facilities, serious questions are raised about the ability of local governments, with limited expertise and resources, to enforce such restrictions. In Michigan, some local governments are requiring special use permit applicants to comply with the generally accepted agricultural management practices developed under the state's right-to-farm law. While this requirement makes identification of appropriate management practices simpler, it does not address the enforcement issue, since there is no inspection of farms under the right-to-farm law unless a nuisance complaint is lodged.

Acceptance of local controls on the siting of livestock operations is not universal. Several states (NC, IA and MO, for example) preclude local governments from using zoning powers to restrict agricultural production practices. There is evidence that state-level actions to restrict the local role can be circumvented when localities are intent upon managing the issue locally. In Pennsylvania, local governments developed an effective patchwork of fairly sophisticated approaches to siting livestock operations and addressing local nutrient management issues. Under pressure from the agricultural industry, the state passed its nutrient management law which, among other things, prohibits local governments from enacting nutrient management requirements more stringent than those included in the state law. In response, local governments abandoned attempts to address nutrient management and turned, instead, to ordinances addressing odors, flies, dust, and other concerns associated with livestock farms.

Siting criteria at the local level deal only with new or expanding facilities. Operations already in existence (as incompatible uses) are subject to neither the site suitability assessment nor the management requirements (unless they choose to expand) of local zoning ordinances. Therefore local zoning alone will not solve the co-existence problems or potential water quality problems associated with existing livestock operations or clusters. The need for regulatory oversight of CAFO management, along with the limited resources available to local governments to implement such

programs, suggests a role for state or federal standards. There is a role for local involvement in ongoing state and federal efforts to police the management of CAFOs -- successful enforcement requires trust and regularity, which means a local presence. The trade-offs incumbent with reliance on local vs. state programs remain an issue, however. A pattern of selective decentralization may successfully address the state-local power struggles (Smith and Kuch 1995).

The Instrumentation Problem. The policy objective of both state and federal environmental regulations governing the operation and management of livestock facilities has been proper nutrient management to protect water quality. However, not all complaints against the industrialization of animal agriculture are quelled with assurances of reliable water pollution prevention. Nuisance damages -- in particular, odor and flies -- provoke neighbors to stage NIMBY (not in my back yard) protests. Neighbors and other community members resist clustering on grounds that it threatens their way of life. The argue that industrialization undermines established rural customs and culture and that factory farms with corporate profit motives replace multi-generational family farms, thus destroying both heritage and livelihoods. Disputes are not just between industrialists from outside and environmentalists or neighbors. Often, the most vehement opposition to clustering often comes from established farmers who fear that they will be put out of business by competition for local resources, competition for market access, and pressure on input prices. Bitterness is most extreme against local producers who abandon their traditional operations and become contract producers. Other farmers view them as traitors. Commenting on the strife in an Iowa community debating the siting of a large-scale hog cluster, David Topel, the agriculture dean at Iowa State University, remarked: "I'm worried about towns getting torn apart (Kilman 1995)."

It is common for livestock producers and their neighbors to reach an impasse about whether and how to site a production facility, and it is even more common for them to disagree about the requirements for satisfactory coexistence. When disputes cannot be settled informally, over the hedgerow, or through mediation staged locally, the plaintiffs go to court (see Vukina, Roka and Palmquist 1996). Lawsuits are often characterized by a legal dilemma: the only policy instruments which give neighbors legal standing against CAFO managers are the federal NPDES permit (written to assure surface-water quality protection) or state regulations on nutrient management, also designed to prevent water pollution. Accordingly, the lawsuit is about the adequacy of the CAFO's

management in averting water pollution, even if the actual problem is really odor or flies or, more abstractly, the disruption of a way of life.

The instrumentation problem arises when plaintiffs use the policy instrument most likely to help them achieve their desired end result, even though they are concerned about other, more ephemeral or difficult-to-measure problems. Often, in court, plaintiffs do not openly discuss the problems (like flies, odor or dust) which are the real sources of the friction between them and their neighbors. Instead, by arguing that a CAFO jeopardizes water quality or fails to meet nutrient management standards, they are able to achieve their goal of blocking the siting of a new CAFO facility or the expansion of an existing CAFO. The problem for CAFO managers, and for the design of flexible policies, however, is that such arguments do not send signals which motivate changes in behavior or technology to address the root problems causing resistance to large-scale animal agriculture.

A recent lawsuit in rural New York illustrates this instrumentation problem. Dick Popps owns and manages Southview Farms, a 2200-cow dairy farm. He was sued by his neighbors and local environmental organization on the grounds that Popps was guilty of non-compliance with his NPDES permit. Allegations included ground water contamination affecting drinking water and surface water contamination from dairy effluent. According to the New York Commissioner of Agriculture and Markets, however, "this case was really about odor" (Merrill 1995, p. 9). Nonetheless, the case imposed significant costs on Popps and his supporters, and resulted in legal precedents with far-reaching ramifications. The dairy farmer and the New York farm organizations supporting him spent $600,000 in legal fees (Roenfedt 1995). Originally, a local jury decided the case in favor of the dairy farmer -- they were not convinced that dairy effluent was responsible for alleged ground water and surface water pollution -- but in an appeal that ruling was overturned (Merrill 1993). The opinion issued by the U.S. District Court of Appeals (New York district) ruled that a 2200-cow dairy farm was a point source of pollution, **including** the adjacent fields where forage crops are raised using manure as an organic fertilizer (Merrill 1995). Popps appealed to the U.S. Supreme Court, but the appeal was not heard (Martin 1996).

When conflict is deadlocked and plaintiffs see no recourse but to settle their disputes in court, then they tend to develop their argument on the issue where their legal standing is the strongest.

There is precedent for such behavior in animal agriculture as in other legal disputes involving agriculture (Hamilton 1995), as well as in lawsuits involving other natural resource management issues such as endangered species management and water allocation. The efficiency of public policies is undermined, however, when lawsuits are staged about water quality even when the underlying issues plaguing the plaintiffs are nuisance or other complaints. Even if the lawsuit is decided in their favor, the plaintiffs are not always satisfied. Furthermore, lawsuits may be delaying tactics rather than actually resolving the issues of interest to the plaintiffs. Thus, even when lawsuits are settled, the problems may not be solved and there may still exist obstacles to harmony between neighbors and in communities with clusters.

Policy Flexibility and Technology Adoption

Instrumentation is a central problem in existing environmental policies addressing livestock agriculture. However, in terms of implementing flexible incentives, current policy design may pose additional constraints to program changes. Flexible incentives, such as performance standards which promote innovation or financial incentives for adoption of new technologies, may not successful if characteristics of the industry, as well as existing environmental policies, are not considered in policy design. In particular, large-scale intensive livestock farmers are facing large capital investments -- high upfront costs -- which may or may not contribute to the profitability of their enterprise. Flexibility, in the case of animal agriculture, will require recognition of such constraints. In this final section, issues of policy design are examined. Then, a discussion of options for improving the probability of success in reducing the environmental and nuisance concerns associated with CAFOs and livestock clusters, while maximizing the returns to public funds invested in program implementation, is presented.

Policy design issues. Critical to the success of any environmental policy for animal agriculture is clarifying how the size of the operation affects designation as a point or a nonpoint source of discharges to water. Clarification of this issue is critical for effective dispersal of the funds allocated to animal agriculture in the EQIP program. However, clarification is also key to answering many questions raised by critics of federal, state and local policies which focus on size of operation as the trigger for increasingly stringent management and siting restrictions. In terms of requiring

careful attention to site suitability or the management of manure, difficulties arise when policies are developed based on the assumption that a 49 animal unit operation is less risky environmentally than a 50 animal unit operation or that a 999 animal unit operation poses less risk to water quality than a 1000 animal unit operation. In addition, it is increasingly difficult to predict the size of a livestock operation which will incite nuisance complaints and neighbor-to-neighbor conflicts.

There are additional questions about the types of manure management practices which will be eligible for cost sharing under the EQIP program. In the past, federal cost sharing funds for manure management have been limited to a standard set of management practices developed by the Natural Resource Conservation Service (NRCS) and satisfying that agency's design and management specifications. Livestock farmers interested in adopting manure management technologies which, despite effectiveness proven in research trials or through use in other countries, are not approved for cost sharing are generally forced, for financial reasons, to choose instead the NRCS-approved standard technologies. For example, a manure management system which involves treatment of waste water so that it satisfies water quality standards for discharge to a receiving water body -- similar to a public waste water treatment technology -- would not be eligible for cost sharing. Cost sharing programs for manure management practices have served as a *de facto* technology standard, creating the same risks of inefficiency and high control costs experienced in other industries subject to technology standards for pollution control. The risk now is that EQIP funds will be distributed to farmers who agree to adopt the same, standard set of manure management practices and that more innovative farmers will be excluded from the program. Thus the inefficiencies of a technology standard may continue, augmented by subsidization of possibly inefficient management practices.

State and local policy makers are increasingly tempted to rely on ratios of number of animals per acre as a way to reduce the risks of excess nutrients leaving the farm operation and entering surface and ground water. However, the number of acres of cropland needed for storage or land application of manure will differ between species and between manure management technologies. Animals per acre ratio restrictions may inhibit the more innovative producers in their investigation and adoption of new management systems. In addition, the capital costs of maintaining a land base adequate to satisfy the requirements may put excess pressure on the financial health of animal operations, while the potential need to limit the number of animals to comply with ratio restrictions

may prevent operators from realizing potential economies of size in production and/or manure management.

Once a CAFO is designated as a point source according to number of animals units, it is subject to a *no discharge* performance standard, a standard to which no other point source discharger regulated by the NPDES program is held. Because of this no discharge standard, the opportunities for CAFOs to adopt innovative manure management and treatment technologies, such as technologies which involve treatment and discharge of effluent, is limited. In addition, despite growing interest in such market-oriented approaches as watershed-based effluent credit trading, CAFOs are prevented by the no discharge standard from participating in such a program. At the root of effluent allowance trading is the opportunity for regulated dischargers to trade off control responsibilities to dischargers with lower control costs. The no discharge standard for CAFOs eliminates them as potential generators of discharge credits (credits generated by reducing discharges below required levels) or as purchasers of discharge credits (credits which allow the purchaser to increase discharges since the increase is offset by the seller's decrease in discharges).

Essentially the no discharge standard requires storage of all liquid and solid manure until it can be applied to cropland, in a raw or composted form, at rates appropriate for crop fertilization. Presumably land application of manures as fertilizer moves the manure management from the realm of point source to nonpoint source discharge, should a discharge to surface waters occur. However, the court's decision in New York's Southview case raises questions about whether land application might also become subject to a no discharge standard, since that decision included the land application practices as a point source. Expanded application of the Southview decision may simply represent a successful way to prohibit animal agriculture in areas where it is not wanted. That is, if a livestock operation larger than some identified trigger size is subject to a no discharge standard and manure cannot be land applied, animal production is effectively prohibited except by smaller operations. Where small livestock operations are finding it increasingly difficult to compete, animal agriculture is likely to exit altogether. Taken to the extreme, the Southview decision and other cases of instrumentation in complaints against livestock farms may exclude animal agriculture from areas which, for reasons of physical features or population distribution, are particularly suitable for large, concentrated livestock production.

Implications for design of flexible incentives. The potential for flexible incentives to minimize environmental and nuisance damages from animal agriculture can be enhanced if programs, especially at the state and federal levels, are targeted to those regions where the greatest benefit per program dollar can be realized. However, this type of targeting differs significantly from the targeting of soil conservation and water quality protection programs that have been implemented previously, such as the targeted erosion control areas identified by the Soil Conservation Service in the early 1980s or the hydrologic unit area water quality programs of the late 1980s and early 1990s. Recently, the Natural Resources Conservation Service's State Conservationist in Michigan expressed the belief that the EQIP program would improve upon previous resource conservation programs because it would target funds to those areas identified as critical by the local-level (county and district) NRCS staff. However, whether such targeting will benefit the livestock issue depends upon the criteria used for identifying critical areas. Rather than merely focusing resources on areas which face particular environmental problems or need significant investments in manure management technologies to prevent such problems, targeting may be more effective if a broader vision of where funds should be allocated is developed -- for example, targeting areas in which the long term viability of the livestock industry can be assured with some degree of confidence.

Early in the process of establishing targeting criteria, a litmus test of industry viability may well be evidence that the animal industry is seen as valuable in a particular state. A financial commitment on the part of state policy makers to support, through research, education and the general policy environment, the kinds of investments that livestock producers will need to make to insure success in the industry is evidence that the industry is valued. For example, in 1994 the Michigan Legislature funded an initiative aimed at revitalization of animal agriculture in the state, providing over $70 million dollars to Michigan State University to modernize and improve research facilities, strengthen research resources and personnel, and build upon Extension outreach capacity. One of the catalysts for this grassroots initiative was recognition that, in a grain-surplus state, Michigan farmers could support an animal industry while adding value to locally produced crops.

Without local support for the siting of animal operations or clusters, however, state-level objectives may be stymied. Local governments have experience in dealing with siting issues related to other land uses. Building upon that experience, while enhancing local expertise and resources, may

be another way in which states can target policy efforts. However, given that natural features and social preferences can vary widely across a state, general acceptability of animal agriculture, especially clusters of large operations, cannot be expected. Instead, resources may best benefit the industry, as well as environmental goals, if clusters can be established in areas where rural economies welcome the financial boost and the physical and climatic features make environmental and nuisance concerns less problematic.

The implication for implementation of EQIP and other flexible incentives is that funds may well be wasted if they are used to install manure management technologies on farms which, because of inadequate local commitment or intense conflict with other land uses, face an increasingly uncertain future. Programs like EQIP could be used not just to help offset farm-level costs of complying with environmental standards but also to steer animal production to those areas which are more suitable both environmentally and economically. This kind of targeting could insure that increasingly scarce resources are not squandered on paying for environmental protection from animal agriculture in areas where animal agriculture may be a waning industry.

A final consideration for EQIP and other programs will be deciding whether federal (or state) funds should be made available to operations already in existence or to new or expanding operations. In the past, animal operations in existence for less than five years were ineligible for federal cost share funds for manure management through programs like the Agricultural Conservation Program (ACP) or the Water Quality Improvement Program (WQIP). The general philosophy was that new operations were expected to include costs of manure management in their decision calculus as they considered entering the industry, while older operations were facing increasing manure management costs because of policies put into place (i.e. a changing of the rules of the game) after they made the investments in their operations. While that philosophy appeals to those who would pursue efficiency through a full accounting of costs in production decisions, it begs the question of whether environmental goals can be reached cost-effectively by subsidizing management changes of older operations, especially if those older operations are less competitive or if they are located in areas increasingly hostile to animal agriculture.

Effective policy design will require more than an operation-by-operation decision on expenditure of limited cost share funds. Flexible policies will be most effective for protecting

environmental quality in animal agriculture if they include broader, multi-level institutional support for animal operations, including informing local siting decisions, minimizing restrictions inherent in requiring (either by dictating technologies, funding specific technologies, or enforcing questionable performance standards) specific management practices, and providing support to industry growth in areas where animal agriculture makes economic and environmental sense.

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