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Economics of Livestock and Poultry Manure Management

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Social Welfare and Manure Management

Management of manure and other byproducts of livestock and poultry production became a prominent public policy issue over the past few years in North Carolina, across the United States, and in other countries around the world. In particular, large-scale livestock and poultry operations were targeted for increased regulation because of the large volume of manure produced at each farm.

Public Interest in Pollution Prevention

Public interest in manure management stems from the potential to pollute groundwater, surface water, air, and soil. Potential pollutants include nutrients such as nitrogen, phosphorus, zinc and copper as well as pathogens and odor. Manure contains nutrients that have intrinsic value as fertilizer. However, the nutrients are in such low concentrations in manure that it generally costs more to store and apply the manure than it is worth as a fertilizer. For example, fresh swine manure may contain 0.6% nitrogen (N), 0.45% phosphorus (P), and 0.45% Potassium (K). When manure costs more to utilize than it is worth as a fertilizer, the economic incentive for farmers is to minimize the cost of using it. Therefore, U.S. livestock and poultry farmers are regulated under federal rules that prohibit any discharge of manure from farms into waters of the state. These rules are in stark contrast to rules that govern how much treated waste municipal and industrial systems discharge daily in rivers and streams.

Public Interest in Economic Activity

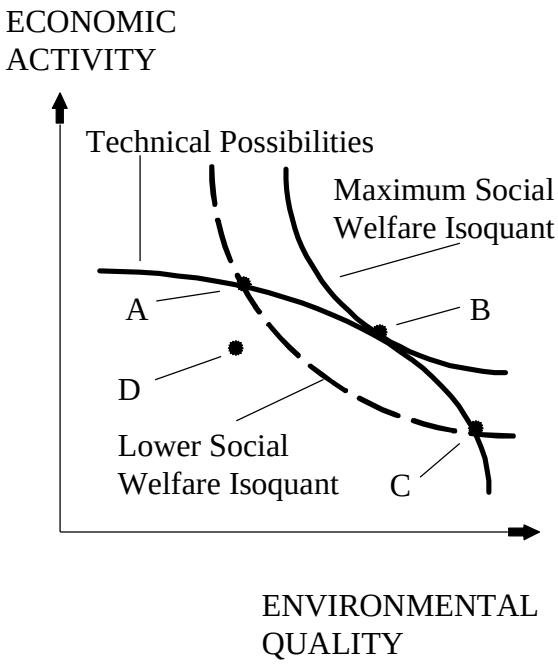
Livestock and poultry production creates jobs, income, property tax base, and sales and income tax revenue both directly and indirectly. In 1997, livestock, poultry, and dairy production (*North Carolina Agricultural Statistics*, 1998) generated 56.5% of the $8.3 billion North Carolina cash receipts from farming. In 1997, hogs ($2.02 billion) and broilers ($1.37 billion), each generated more farm cash receipts in North Carolina than tobacco ($1.19 billion). The economic benefits of livestock and poultry production can also result in substantial improvement in economic welfare in rural communities where few alternatives for income and employment exist. For example, Duplin County is listed among the top four counties in North Carolina in an index of overall economic well being and growth over the past five years, and hog production is the reason cited (*Business North Carolina*, February, 1999).

Socially Optimal Production

Economics is the study of optimal resource allocation to maximize the welfare of people. Critical determinants of optimal resource allocation are people's preferences, the resource base and current technology. People value environmental quality, income, employment, and public services provided by tax revenues. Economists portray people's preferences for various

combinations of goods and services with a utility function. Figure 1. includes two upward-bending curves labeled **social welfare isoquant.** A welfare or utility isoquant is the **set of all combinations of goods and services that would provide the same level of utility or welfare** to the people whose preferences the isoquant represents. In Figure 1. the two goods and services are **environmental quality** and **economic activity.** The utility isoquant that is higher and farther to the right portrays a higher level of utility. People prefer the combinations of goods and services on the higher isoquant to those on the lower isoquant.

Figure 1. Socially Optimal Production



Source: Marra, M., and K. Zering, *Finding the Best of the Best in Water Quality BMP's: The Economist's Viewpoint*, AREP96-1, Department of Agricultural and Resource Economics, North Carolina State University, October, 1996.

The downward-bending curve in Figure 1. labeled **technical possibilities** depicts the maximum levels of two goods and services that can be attained by people with the current level of technology. The shape of the curves indicates that as we shift towards more of one good or service, we give up larger amounts of the other good or service. For example, if we move along the technical possibilities curve to increase environmental quality, we give up economic activity.

The socially optimal combination of environmental quality and economic activity is depicted in Figure 1. as the point labeled ***B.*** This point attains the maximum level of social welfare possible given current technical possibilities. Point ***A*** represents more economic activity and less environmental quality. Point ***A*** is preferred to point ***B*** by some individuals or communities with a stronger preference for economic activity. Similarly, individuals or communities with a stronger preference for environmental quality might prefer point ***C.*** Both points ***A*** and ***C*** result in a lower level of social welfare based on society's preferences although they are both technically efficient. Point ***D*** depicts a combination of environmental quality and economic activity that is neither technically efficient nor socially optimal. Society could have more of both goods and services without having less of either compared to point ***D.***

A few basic principles of public policy design arise from this abstract model of social welfare maximization. First, **the value of environmental benefits derived from any policy or regulation should exceed the net direct and indirect cost it imposes.** Otherwise, society is worse off. Information required for this evaluation includes clear measures both of environmental benefits and of the net costs imposed by policy. Costs may include government costs of implementing the policy; private costs of complying with regulations; and lost income, employment and tax base when regulations result in reduced economic activity. Net costs are costs minus any non-environmental benefits that are

realized as a result of the regulation. Non-environmental benefits may include savings in other government expenditures, reductions in other private costs as a result of the regulation, and any additional economic activity generated by the regulation.

Secondly, **any environmental benefit should be achieved at the lowest net direct and indirect cost possible.** Otherwise, society could have enjoyed the same benefits at lower cost and have been better off. Information required for this second evaluation includes the environmental benefits and net costs of other methods of improving or sustaining environmental quality.

Broad social preferences are expressed in consumer choices and through the political and legal systems in the form of laws and regulations. The efficiency with which laws and regulations are implemented depends on government agencies as well as private and public research institutions that provide information.

Socially Optimal Manure Management

Various levels of government, farmers and other citizens seek socially optimal manure management. Regulation and markets are two methods of achieving that goal. In the absence of regulation, some farmers may create unnecessary environmental impacts. Arbitrary and inflexible regulation may result in unnecessary cost and loss of economic activity. Both of the cases described here are depicted by point **D** in Figure 1.

Point **A** in Figure 1. depicts the case where regulation and markets cause farmers to operate manure management systems efficiently, but the chosen systems achieve too little environmental quality. Point **C** depicts the case where regulation and markets cause farmers to operate manure management systems efficiently, but the chosen systems result in too little economic activity.

North Carolina adopted nutrient management guidelines in 1992 for livestock and poultry farms that use liquid manure handling systems. Those rules required that manure be applied to land at no greater a rate than would allow the crop to use the plant available nitrogen in the manure. Laws regulating hog farms have been adopted by each session of the North Carolina legislature since 1995. The U.S. Environmental Protection Agency is developing new national rules for livestock and poultry farms. Clearly, there has been political momentum for more regulation.

North Carolina regulations to date may have reduced the incidence of inefficient manure management and increased the cost of regulatory compliance and enforcement. Political debate continues about whether or not through regulation to impose a change from the current manure management system to some alternatives. A critical question in that debate is whether or not such a shift would increase social welfare. If it can be shown that such a change would meet the two criteria listed in the previous section, it would be depicted as a shift from point **A** towards point **B**. If the proposed change fails to meet those criteria, then it would be depicted as a shift away from point **B** towards point **C** or point **D.**

There is a great need for information to support new regulation of livestock and poultry farms. Research currently underway in North Carolina and elsewhere is attempting to measure the actual environmental effects of livestock and poultry farms. The NCSU Animal and Poultry Waste Management Center is evaluating alternative manure management technologies and products to determine their cost and their effectiveness in preventing potential environmental effects. Other studies are attempting to identify sources of nitrogen in the Neuse River basin to determine what nitrogen reduction strategies will be the most efficient.

The trade-off between economic activity and stricter environmental regulation can be very tangible for counties such as Duplin and similar rural communities in North Carolina. Profit

margins are slim and volatile in livestock and poultry farming as in most areas of agriculture. Unlike municipal and industrial waste treatment systems, farmers are unable to pass cost increases along to taxpayers or consumers. A small percentage increase in costs may eliminate profits for most producers, terminate their farming operations, and sharply reduce economic activity in their communities.

Socially optimal manure management is defined by: (1) measuring the **actual** environmental impact of current and proposed manure management systems; (2) comparing their costs; (3) comparing the costs of reducing environmental damage from other sources such as municipal treatment plants; (4) designing a policy to enhance environmental quality at the lowest net cost possible; and (5) including policy to minimize imposed individual and regional hardship.

Policy Tools for Changing Technology

New environmental regulation can render widely used technology unacceptable. This action effectively condemns the specialized assets that farmers or others have committed to the widely used technology. The regulatory action may also condemn their farming operation if no other economically feasible technology exists. The indirect effect of the regulatory action may also be to condemn businesses and tax base dependent on those farms.

Policy tools to mitigate the severe economic effects of condemning technology include paying for the replacement technology including initial investment and any additional annual operating costs. This payment may be in the form of direct payments, tax credits for annual costs, tax deductions, subsidized credit, discounted utility prices, subsidized biosolids removal, or revenue from discharge permit trading programs. Once again, these costs should be the least costly method of achieving the desired environmental benefits and should be exceeded by the value of the environmental benefits.

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