



United States
Department of
Agriculture



Economic
Research
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ERS Research Briefs

Manure Management for Water Quality: Cost to Animal Feeding Operations of Applying Manure Nutrients to Land

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AER - 824

June 2003



Full report follows
Research Brief.

New Water Quality Guidelines Affect the Way Manure is Managed

U.S. farmers are world leaders in the production of animal products. But in supplying households with hamburgers, pork chops, and ice cream, livestock and poultry farms also generate more than 350 million tons of manure that must be disposed of every year. When used as a fertilizer, livestock and poultry manure can provide valuable organic material and nutrients for crop and pasture growth. However, those same nutrients—nitrogen and phosphorus—can degrade water quality if they are overapplied to land and enter water resources through runoff or leaching. A shift in the livestock and poultry industry over the past several decades toward fewer, larger operations and toward regional concentration has prompted public concern over the use and disposal of animal manure.

What Is the Issue?

Animal feeding operations identified as CAFOs (concentrated animal feeding operations, generally the largest) under the Clean Water Act are considered a point source of water pollution. As such, they are required to obtain a permit and show that they are not discharging waste into surface waters. In 2003, EPA further required that each CAFO develop and implement a nutrient management plan. Manure spread on land (the primary disposal method) must not be applied at greater than agronomic rates, or rates that oversupply nutrients to crops or other vegetation. In addition to these new requirements for CAFOs, USDA's stated goal is that all animal feeding operations develop and implement technically sound, economically feasible, and site-specific nutrient management plans.

Farmers are concerned that meeting a plan's requirements increases the costs of managing manure - developing a nutrient management plan, recordkeeping, testing the nutrient content of manure and of soil receiving manure, and possibly transporting and applying manure to more land. In this report, we examine how much costs increase and how net returns and prices adjust as a result. If animal operations are overapplying manure nutrients, the cost of moving manure to additional land can become a major expense. The availability of nearby land off the farm for spreading manure becomes a major concern for animal operations without enough land of their own.

How Was the Study Conducted?

We use survey data for hogs and dairy to estimate the short-term, **farm-level** implications of applying manure to land according to a nutrient management plan across U.S. regions. This analysis best captures the interactions between a farm's resource base and

manure disposal decisions, including how much land livestock farms would require beyond what they currently control, as well as the cost of hauling manure to this land. Both nitrogen- and phosphorus-based nutrient standards are assessed.

In some areas of the country, animal operations have become concentrated and land availability for spreading manure is insufficient. A **regional** model for minimizing manure transportation and spreading costs is developed and used to examine how the competition for land on which to spread manure influences the costs of spreading manure.

The impacts of a national policy are felt across regions, and these impacts can be transferred **across the economy** through the market system. We assess the broader impacts of improved manure management on the welfare of U.S. producers and consumers with a model of the U.S. agricultural sector. We estimate the impacts of meeting nutrient application plans on agricultural prices, crop and animal production, and the geographic distribution of production.

What Did the Study Find?

Meeting nutrient application standards will require CAFOs to spread their manure over a much larger land base than they are currently using, and most will need to move their manure off the farm. For example, only 18 percent of large hog farms and 23 percent of large dairies are currently applying manure on enough cropland to meet a nitrogen nutrient plan. Even if large hog farms spread manure over their entire land base, only 20-50 percent operate enough land to meet land application standards, depending on whether a nitrogen- or phosphorus-based plan is to be met. Similar results would be expected for beef and poultry.

Total livestock/poultry farms' annual net income could decline by more than \$1 billion (around 3 percent), but the precise outcome depends greatly on the extent to which cropland operators are willing to substitute manure for commercial fertilizers, and the degree to which revenue from sales of higher priced animal products mitigates increases in production costs.

Competition for land on which to spread manure could be severe in regions with high concentrations of animals. Animal feeding operations in 2 to 5 percent of U.S. counties produce more manure nutrients than can be absorbed by total cropland and pasture in each county. Those counties are primarily in North Carolina, States surrounding the Chesapeake Bay (Virginia, Maryland, and Delaware), Southeastern States (such as Georgia, Alabama, and Arkansas), and in California. Operations in those regions would have to compete for land if all manure is to be spread at agronomic rates. This could extend travel and raise costs.

Crop producers' willingness to accept manure is a very important determinant of manure spreading costs. In all analyses, costs decrease when more crop operators are willing to use manure. A number of factors impede greater use of manure, including uncertain nutrient content, soil compaction associated with heavy manure application machinery, and odor. Research on how these impediments might be overcome, education assistance on the benefits of using manure, and financial assistance for crop farmers using more manure could reduce farmers' manure management costs and secure better water quality.

The costs of complying with manure management requirements could instigate structural and geographical shifts in the livestock and poultry sectors. Our analysis indicates that the highest per-unit costs for meeting a nutrient-based manure management plan are often borne by the largest operations. Sectors such as swine and poultry have seen a significant move toward integration, the use of production contracts, and larger farms, primarily because of the efficiencies these structural changes bring. The impacts of manure management costs on the potential benefits from this structure could influence whether such trends continue, whether smaller operations (non-CAFOs) not affected by current regulations become more competitive, and the degree to which location will be considered in expansion decisions.