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Proposed Requirements for Manure Nutrient Management: Potential Sector Impacts

Animal feeding operations (AFOs) produce most of the nation's livestock and poultry. Manure from these facilities is rich in nitrogen and phosphorus, and these nutrients are important for crop production. However, when their application to land exceeds crop needs, and when manure storage spills or leaks occur, the runoff can enter waterways and impair water quality. In December 2000, the U.S. Environmental Protection Agency (EPA) proposed bringing additional AFOs under Clean Water Act regulation and requiring improvements in manure management, including implementation of nutrient management plans by all regulated AFOs. A final decision is expected by December 2002 on the proposed rules, which could affect not only additional AFOs but also regional livestock and poultry production, prices, and net returns.

Increasing concentrations of AFOs geographically, as well as the general increase in the size of these facilities, are generating concerns over manure and water quality. Geographically concentrated production of livestock and poultry can generate manure nutrients in excess of what can be used agronomically within the watershed

while maintaining water quality. In 1997, 60-70 percent of manure nutrients were produced on operations that had insufficient land to absorb the nutrients at application rates not exceeding crop needs. Also over the past several years, major lagoon spills or leaks in Illinois, North Carolina, Iowa, Kentucky, Minnesota, Missouri, Montana, South Dakota, Utah, Virginia, Washington, and Wisconsin led to high-profile media coverage that raised public demand for greater regulation and preventive measures.

What EPA Has Proposed

EPA has proposed regulatory changes affecting all "Concentrated Animal Feeding Operations" (CAFOs) in response to growing public concern about water quality impairments from nutrients, pathogens, and pharmaceutically active compounds associated with manure and wastewater from AFOs. EPA currently defines a CAFO as an operation with at least 1,000 animal units (AUs). One proposed change would define CAFOs based on operation size alone, and at the extreme could include all AFOs with 300 AUs or more. This would bring under regulation the largest 20 percent of the AFOs nationwide

and approximately 70 percent of all AUs and manure production.

A second proposed change would require each CAFO to develop and implement a nutrient management plan (NMP) that restricts land application of livestock and poultry manure to rates that do not exceed the nutrient needs of whatever crop, including pasture, is on that land. CAFOs would apply manure to their own land to the extent permitted by the NMP, then arrange with other willing land operators to accept the balance of the manure as an alternative or supplement to commercial fertilizer. These producers would have to limit nutrient application to amounts not exceeding crop needs. When the manure is applied to another producer's land, the CAFO may or may not incur the additional cost of transporting and properly applying the manure, depending upon the specific arrangement. The proposed regulatory changes will be finalized by December 2002, with plans to publish them in the Federal Register by January 2003.

The principal costs a CAFO would incur to meet the NMP requirements are:

- fixed cost of developing and managing the NMP, estimated at approximately \$1,300 per year per operation, regardless of size;
- cost of land application of manure, estimated to average around \$2 per acre; and
- manure transport costs averaging between \$0.007 and \$0.14 per ton of manure, depending upon the distance to the land available for application.

These costs represent annual average costs across the nation and are taken from a recent EPA study on the costs of the proposed CAFO rule. CAFOs will likely consider these NMP costs along with other costs of manure storage and handling when deciding on the number and kind of animals to feed or even whether to stay in business. The NMP costs may be high enough to make unprofitable some marginally viable CAFOs. The collective decisions of CAFOs could have national and regional impacts on livestock, poultry, and crop production; on net returns to livestock and poultry producers; on nutrients generated; and on prices for leading

food commodities from the livestock and poultry sectors.

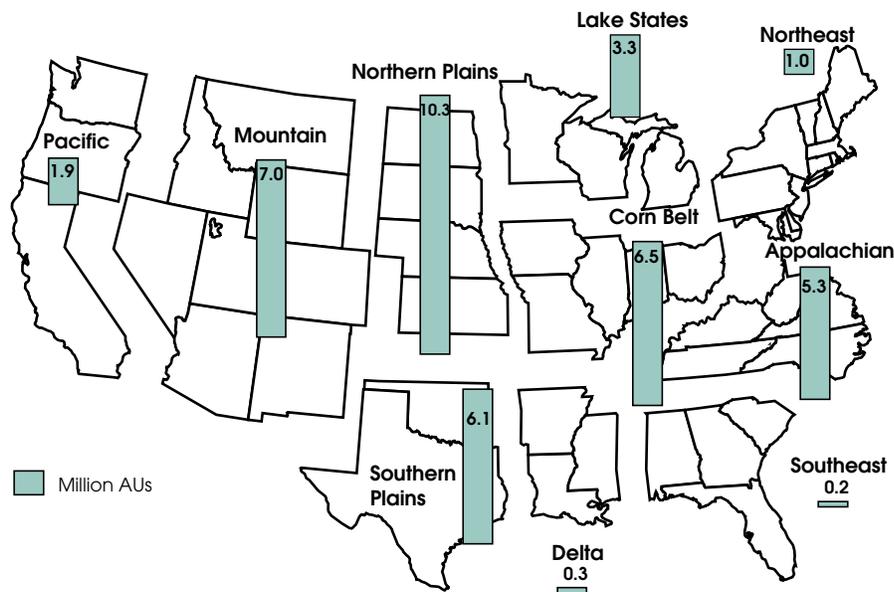
Two key factors affect manure transport costs and land application on a regional basis. The first is the amount of manure produced (based on the total AUs in CAFOs) relative to the overall amount of cropland within a region. The second factor deals with the amount of cropland that crop producers make available for application of manure under the conditions that CAFOs must meet (pasture and grazing lands are not considered in this analysis because of their low capacity to assimilate manure nutrients above those from current animal grazing.)

Willingness to make cropland available for manure application is an unknown but potentially major hurdle to managing manure nutrients. In the late 1990s, U.S. farmers applied manure to 9-17 percent of land in corn and soybeans as a supplement or substitute for commercial fertilizer. But will producers accept manure for 40 percent or more of an area's crop nutrient needs, or even 20 to 30 percent? Some crop producers may be reluctant to accept manure given the inherent variability in its nutrient content and the possibility that the manure nutrient content and/or the ratio of those nutrients will not meet the needs of the crops. Also, some producers may be concerned about the potential presence of pathogens or other undesirable elements. In addition, manure is more difficult to handle than commercial fertilizer. In any event, the greater the willingness of crop producers to accept manure the greater the availability of land for spreading manure and the lower the average cost of manure dispersal.

How Substantial Are National/Regional Impacts?

Using a 10-region agricultural model, analysts at USDA's Economic Research Service estimated the national/regional impacts of the proposed regulations. The model predicts how producers would alter livestock and poultry production over time in response to the costs of transporting manure under potential levels of manure acceptance by crop producers. The model examines how the changes in production affect national/regional supply and demand for crops and livestock, com-

Number of Animal Units (AUs) on Animal Feeding Operations Varies Regionally



Includes animal (livestock and poultry) feeding operations with 300 or more AUs (an AU = 1,000 pounds of live animal weight).

Economic Research Service, USDA

The U.S. Mathematical Programming Model for Agriculture

To estimate changes in production, nutrient generation, prices, and net returns to livestock and poultry producers, ERS uses a U.S. regional agricultural sector model designed for general-purpose economic, environmental, and policy analysis of the U.S. agricultural sector. The model represents agricultural markets and production enterprises in considerable detail and all elements of the model are calibrated to the latest available baseline, geographic, and cost-of-production data. The model is linked with regularly updated USDA production practice surveys, and geographic information system databases such as the National Resources Inventory.

The model predicts how changes in farm resources, environmental or trade policy, commodity demand, or technology will affect supply and demand of crops and livestock, farm prices and income, use of production inputs, participation rates and government expenditures for farm programs, and environmental indicators (such as erosion, nutrient and pesticide loadings, greenhouse gases, and others).

modity prices, farm income, and nutrient generation. Predictions from the analysis assume that NMP costs and land availability constraints affect all AFOs that feed 300 or more animal units—the smallest operation size being considered under the regulation proposal.

The analysis estimated and compared the results of three alternative manure acceptance scenarios with the results of a base-year situation that assumed no federal or state restrictions on land application of manure.

- **High-acceptance scenario.** Assumes that crop producers in each region will accept manure to satisfy up to 40 percent of the region's crop nutrient needs. (Agricultural sector impacts were found to be mostly negligible above 40 percent.)
- **Medium-acceptance scenario.** Assumes that crop producers in each region will accept manure to satisfy only up to 30 percent of the region's crop nutrient needs.

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- **Low-acceptance scenario.** Assumes crop producers in each region will accept manure to satisfy only up to 20 percent of the region's crop nutrient needs.

The model allows the impacts of the NMP costs and manure acceptance constraints to work themselves out over time (i.e., over the next eight years). Only aggregate changes are estimated; the impacts of the proposed CAFO rules on individual operations cannot be addressed in this type of analysis. The analysis also assumes a stable amount of total cropland over time, a stable level of willingness to accept land application of manure, and a stable set of technologies for managing and using manure.

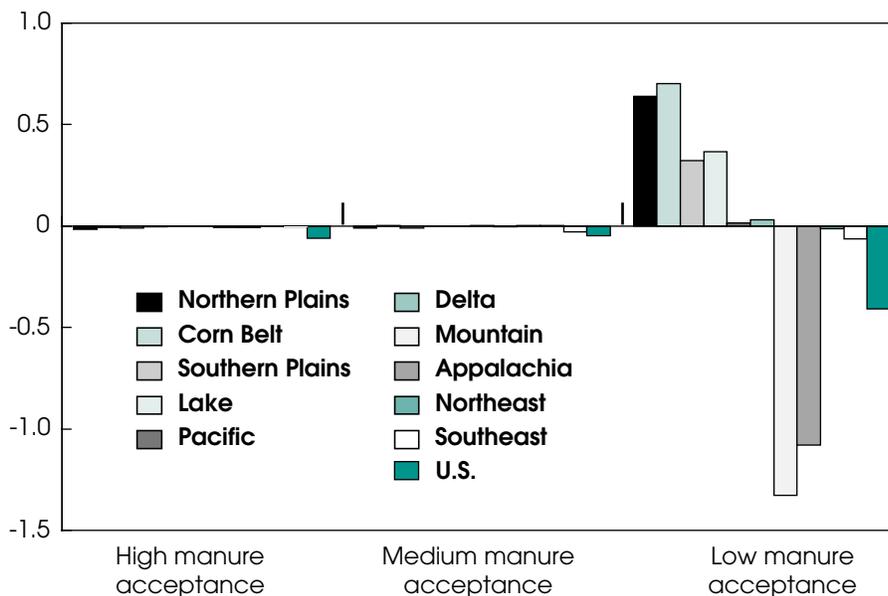
Production impacts. In general, the results suggest that the implementation of nutrient management plans on operations feeding 300 or more AUs will not be highly disruptive to livestock and poultry production if crop producers are generally willing to accept manure from CAFOs. Cropland availability is essential for NMPs. The more land that is in crop production in a region and in proximity to CAFOs, the less costly is the NMP requirement that manure nutrients be applied to cropland at proper rates.

The costs of developing and implementing NMPs could motivate some shift in animal production to regions with greater available land for manure application, while decreasing U.S. animal production overall. The potential production impacts are marginal in the high-acceptance scenario—all regions decrease AUs by less than 1 percent except for the Southeast, which declines by only 2 percent. Under the medium-acceptance scenario, the Southeast decreases AUs by 14 percent, while small production increases occur in the Northeast and Delta regions. Only in the low-acceptance scenario when land available for manure application is highly constrained does predicted production shift substantially among regions. AU decreases of 19-30 percent occur in the Southeast, Appalachia, and Mountain regions, while increases of 5-11 percent occur in the Lake, Corn Belt, Northern Plains, Delta, and Southern Plains.

Under Proposed Manure Nutrient Management Requirements:

Livestock and Poultry Production Could Decrease Nationally and Shift Regionally. . .

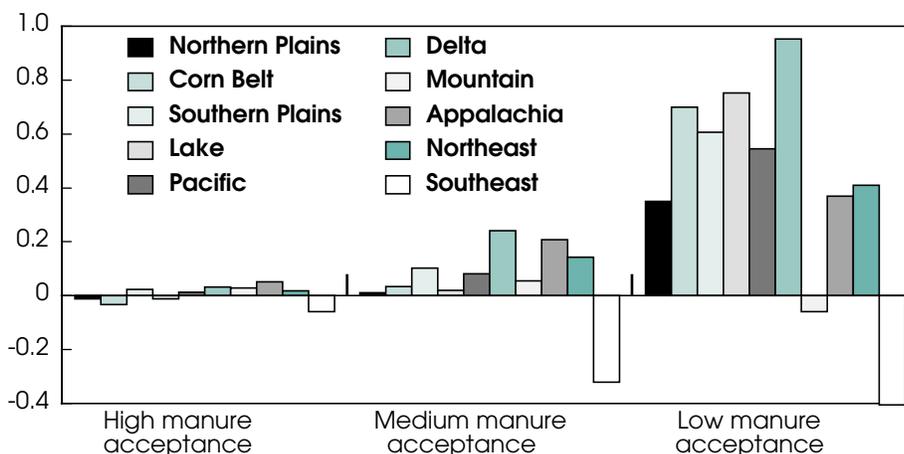
Change in AUs from base situation (million)



Number of animal units on animal feeding operations. AU = Animal unit (1,000 pounds of live animal weight).

. . .and Aggregate Returns to AFOs Could Rise in Most Regions

Change in net returns from base situation (\$ billion)



Based on analysis using a regional agricultural model. Assumes animal feeding operations (AFOs) of 300 animal units and above would have to implement nutrient management plans. High, medium, and low acceptance levels reflect producers' willingness to accept manure to satisfy 40, 30, and 20 percent of total crop nutrient needs in the region.

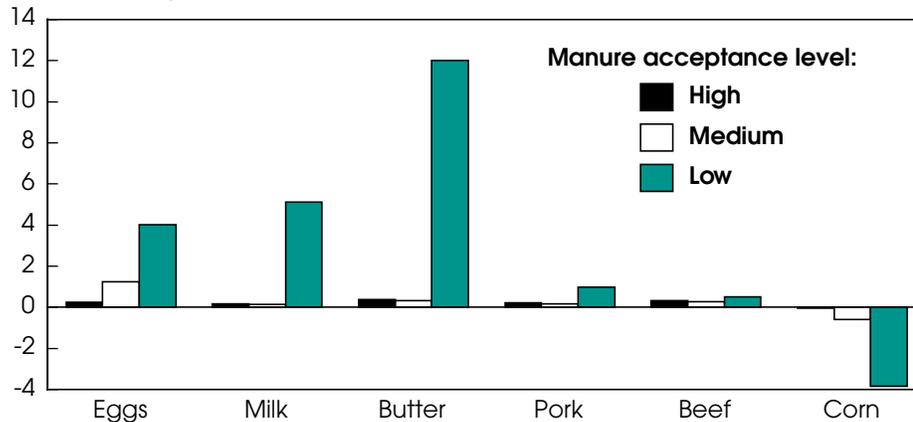
Economic Research Service, USDA

Regional changes in animal production translate into changes in manure nutrient generation. For the most part, these

changes mirror production changes. Where animal units increase, manure nutrients increase. The increases in

Proposed Requirements for Manure Nutrient Management Could Lead to Higher Animal Product Prices and Lower Prices for Corn

Percent change in price from base situation



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Economic Research Service, USDA

manure nutrients are not detrimental to water quality per se, only if mismanaged. The threat to water quality can be reduced when manure nutrients replace or supplement commercial fertilizers and, according to EPA's proposed CAFO rules, total nutrients applied do not exceed the nutrient needs of the crops.

Decreasing livestock and poultry production would reduce the demand for animal feeds, which could lower certain feed crop prices (such as corn) and acreage devoted to those crops. These effects would induce changes in overall crop production acres. In general, the predicted changes to crop production are less than 3 percent throughout the U.S. The aggregate savings to crop producers from using manure nutrients instead of commercial fertilizer are potentially between \$2 and \$4 billion, depending on the scenario. These savings do not account for the cost of transporting the manure to crop producers willing to accept it, which may or may not be paid by the CAFOs depending upon the specific arrangements. Also, some of these savings may go to CAFOs that apply manure on their own land as a substitute for commercial fertilizer.

Impacts on prices and net returns.

Decreases in animal production nationwide translate into higher livestock and

poultry prices. These higher prices coupled with a decrease in animal feed cost (lower corn price from lower feed use) result in net gains for all unregulated AFOs, given the assumption that these AFOs do not adopt NMPs and thus avoid the associated costs. The effect on the CAFOs is less clear, since they will bear the cost of developing and implementing NMPs. Some CAFOs that are already marginally viable will likely be forced out of business, while others experience lower returns due to other costs associated with changes in manure handling and storage. The current analysis does not allow us to capture these losses.

Given the nature of supply and demand within the livestock and poultry sectors of the U.S. economy, higher output prices and lower input costs more than offset the costs of NMPs and the decreases in actual animal production, resulting in higher net revenues for the industry as a whole. The overall increase in net returns to all AFOs ranges from approximately 0.5 percent under the high acceptance scenario to 16 percent under the low-acceptance scenario. These results might be surprising to some because the cost of NMPs rises as transport costs go up. However, increases in prices for animal products caused by the relatively greater declines in production associated with low manure acceptance more than compensate for the cost increases.

Regional impacts differ. Most notably, model results show net returns to AFOs declining in the Southeast and Mountain regions when crop producers have relatively low manure acceptance. This decline reflects both increased net returns to unregulated AFOs and decreased returns to CAFOs. The requirement that nutrients be applied at rates that do not exceed crop needs forces CAFOs in these regions to decrease the number of animals to such a level that they do not receive the overall benefit from increased prices. When manure acceptance is at a medium level, net returns to AFOs only in the Southeast show decreases associated with the land application restrictions. However, when manure acceptance is high, several regions show slight decreases in net returns. Net returns to CAFOs fall because the increases in livestock and poultry prices are not as significant as under the low- and medium-acceptance scenarios and do not offset the increased cost of implementing NMPs.

Changes in prices for products from the livestock and poultry sector indicate, not surprisingly, that restricting animal production results in higher retail prices for such commodities as milk, butter, pork, and beef. While these higher prices adversely affect consumers, livestock and poultry producers experience greater net returns ranging between \$50 million and \$4 billion, depending on the level of manure acceptance and resulting transport costs. The potential losses to consumers from the higher retail prices are relatively small (less than 0.16 percent). A full calculation of the effects on consumers would also include any benefits derived from improved water quality. This analysis has focused only on the potential impacts of developing and implementing NMPs on the U.S. agricultural sector.



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For more information:

Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients: Spatial and Temporal Trends for the United States
www.nhq.nrcs.usda.gov/land/pubs/man-ntr.html