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Cost of Meeting Manure Nutrient Application Standards in Hog Production: The Roles of EQIP and Fertilizer Offsets

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The Environmental Protection Agency requires concentrated animal feeding operations to develop and implement a comprehensive nutrient management plan. Changes in manure management to meet nutrient application standards will increase production costs. Some of these costs can be offset by savings from replacing commercial fertilizer with manure nutrients, and through financial assistance programs such as the U.S. Department of Agriculture's Environmental Quality Incentives Program (EQIP). A manure application cost model was used to examine the costs to confined hog farms of meeting nutrient application standards, and the ability of fertilizer offsets and EQIP to reduce these costs.

Livestock and poultry manure can provide valuable organic material and nutrients for crop and pasture growth. However, nutrients contained in animal manure can degrade water quality if they are overapplied to land and can enter water resources. Animal waste is a source of both nitrogen and phosphorus, the nutrients of greatest water quality concern.

Hogs provide a good example of why animal waste has become a major focal point of environmental policy. A shift in the industry over the past decade toward fewer, larger, spatially concentrated operations has prompted concerns over the utilization and disposal of animal waste. In 1982, there were 175,284 U.S. farms with confined hogs, totaling 6.3 million animals (U.S. Department of Agriculture, Economic Research Service, 2002a). By 1997, the number of farms had shrunk to 63,723 (down 64%), while the number of hogs had increased to 8.2 million with many more hogs on large facilities. An estimated 51% of the recoverable (nitrogen remaining after manure collection and storage) nitrogen in hog manure and 64% of the recoverable phosphorus was in excess of crop nutrient needs at the farm

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level in 1997 (Gollehon et al.). Excess nutrients are prone to leaving the field and polluting water resources.

In response to increased environmental concerns, the Environmental Protection Agency (EPA) introduced new regulations for concentrated animal feeding operations (CAFOs) under the Clean Water Act. One of the changes is to require that CAFOs applying manure to land meet nutrient application standards defined by a comprehensive nutrient management plan (CNMP) (U.S. Environmental Protection Agency). The standards can be nitrogen or phosphorus based, depending on the nutrient content of the soil. In addition, the U.S. Department of Agriculture (USDA)[1] is encouraging the voluntary adoption of CNMPs by all animal feeding operations (AFOs) not subject to EPA regulation (U.S. Department of Agriculture, Natural Resource Conservation Service, 1999b).

Developing and implementing a nutrient management plan entails costs for the producer, including plan development, soil testing, manure nutrient testing, manure hauling and application, and recordkeeping. Land application of manure to meet a nutrient standard may be particularly costly if large amounts of additional land are needed to prevent overapplication of nutrients, requiring manure to be hauled off the farm. Two types of offsets can reduce costs. A commercial fertilizer offset occurs when manure has been overapplied and meeting nutrient application standards result in more cropland receiving manure. Manure nutrients can replace commercial fertilizer on the additional land. A second potential source of cost offset is USDA's Environmental Quality Incentive Program (EQIP). EQIP offers financial assistance for several conservation practices that help farmers utilize manure more efficiently. In the final CAFO rule, EPA specifically identifies EQIP as a source of funds for helping CAFOs implement a CNMP (U.S. Environmental Protection Agency). In this paper, we assess the costs to hog operations of meeting nutrient standards and the potential for cost offsets to defray increases in production costs. We also assess the potential aggregate demand for EQIP funds on the part of confined animal operations in relation to funding levels authorized in the 2002 Farm Act.

EQIP and Manure Management

The EQIP provides technical assistance, cost-share payments, and incentive payments to operators of working farms for implementing conservation practices. EQIP was introduced in the 1996 Federal Agriculture Improvement and Reform Act and amended by the 2002 Farm Security and Rural Investment Act (2002 Farm Act). The program is managed by the USDA's Natural Resource Conservation Service (NRCS). Assistance can be in the form of a cost-share payment (percentage of implementation cost) or incentive payment (per acre payment based on activity). Incentive payments are not strictly based on implementation costs, but on what it takes for an operator to adopt the practice. AFOs can receive financial assistance for waste management structures and various handling and application practices. Contracts for financial assistance are for 1–10 years, with a maximum of $450,000 per farm over FY2002–2007 (U.S. Department of Agriculture, Economic Research Service, 2002b). By statute, 60% of the available funding for the program is earmarked for practices related to animal production. EQIP was funded at about $200 million per year from 1996 through 2000. Funding is authorized to increase

incrementally from $400 million in 2002 to $1.3 billion in 2007. All farmers are eligible for EQIP on a first-come, first-served basis. Large animal operations initially were ineligible for EQIP funds. This was changed in 2002 to assist large operations in meeting EPA's regulations.

The specific practices farmers can use to help them meet manure nutrient standards include the following:

Nutrient management involves managing the amount, source, placement, form and timing of the application of nutrients, and soil amendments. One of its purposes is to "properly utilize manure or organic by-products as a plant nutrient source" (U.S. Department of Agriculture, Natural Resource Conservation Service, 1999a, p. 1). A payment is made on a per-acre basis for developing and implementing a nutrient management plan. Activities covered by this practice include the development of the plan by a certified specialist, soil testing, plant tissue testing, nutrient application timing, nutrient application rates, field risk assessment, and heavy metals monitoring.

Waste utilization is using agricultural wastes, such as manure and wastewater from livestock and poultry operations as a nutrient source and to improve soil tilth (U.S. Department of Agriculture, Natural Resource Conservation Service, 2001). The payment is on a per acre basis for lands on the hog farm receiving waste in an approved manner, and is intended to cover the development of a waste management plan, the application of waste according to that plan, and recordkeeping. Where wastes are utilized to provide nutrients to crops, the practice Nutrient Management must also be followed.

Manure transfer refers to a conveyance system using structures, conduits, or equipment for moving manure (U.S. Department of Agriculture, Natural Resource Conservation Service, 1997). The purpose of this practice is to transfer animal manure to a manure storage/treatment facility, a loading area, or to agricultural land for final utilization. Manure transfer is part of a planned agricultural manure management system. Payments for manure transfer are typically 50% of hauling costs for manure moved off the farm.

Other EQIP-supported practices that might complement manure nutrient management, such as soil erosion control, vegetative buffers, and manure storage handling structures, are not considered in this paper.

Nutrient Application Standards

Our manure nutrient application standards are based on NRCS nutrient management policy. The CAFO final rule states that permitting authorities may use the NRCS Nutrient Management Conservation Practice Standard as guidance for developing applicable nutrient application standards (U.S. Environmental Protection Agency). Nutrient management criteria are established by the NRCS conservation practice standard to provide adequate nutrients for crop growth and to minimize the potential for adverse environmental effects (U.S. Department of Agriculture, Natural Resource Conservation Service, 1999a). The primary criterion within these policy documents are that land application rates for nutrients be based upon Land Grant University nutrient application recommendations.

A nutrient application standard can be either nitrogen (N)- or phosphorus (P)-based. A manure application rate based on a nitrogen standard supplies all the nitrogen needed by crops, but it also generally overapplies phosphorus. The ratio of phosphorus to nitrogen in manure is generally higher than crops require (Mullins). NRCS policy permits use of the nitrogen standard on sites for which supplemental phosphorus is recommended, or when a risk assessment tool has determined that the risk for off-site transport of phosphorus is acceptable. (The phosphorus index is currently the most widely used risk assessment tool for this purpose.) Otherwise, the P standard must be followed. Following a P standard often requires supplemental nitrogen from commercial fertilizer.

What the Literature Says about Manure Use

The literature suggests that AFOs might treat manure as a waste rather than a source of nutrients, and therefore overapply it to land. Henry and Seagraves presented the basic economics of transporting animal waste. They recognized the potential environmental problems from poultry litter as that sector was moving toward larger production facilities. The two most important factors that determine the net value of manure are its nutrient content and the distance it needs to be hauled before it is used. Nutrient content enhances manure's value, while transportation distance reduces it. The authors concluded that the unprofitability of moving litter long distances (because of an unfavorable weight-to-nutrient ratio) leads to overapplication on land near the production houses. With higher application rates that exceed crop needs, the value of manure drops because crops cannot utilize the extra nutrients.

Roka and Hoag looked for evidence that swine producers factor the value of manure into their livestock management decisions. In their estimation, a farmer makes three decisions that affect the on-farm value of manure: choice of a treatment system, choice of area receiving effluent, and choice of crops grown. The authors found that the value of pork dominates a producer's hog production decisions, and that producers are relatively insensitive to the value of manure. Under the most favorable conditions, manure value is negative (−2.94/head), yet production cycles or other management options were not changed in order to increase manure's value. Manure's negative value may prompt farmers to view it as a waste rather than a resource, leading to overapplication on land nearest the production facility.

Innes developed a conceptual model of livestock/poultry production and regulation to illuminate the issues of manure generation and management. The model represents the waste management decisions of private animal producers, manure impacts on the environment, the effect of market forces, and implications for the design of efficient government regulatory policies. The model includes spills from animal waste storage (lagoons), nutrient leaching and run-off from fields, and direct ambient pollution from animal operations, including odors, pests, and ammonia gases.

Innes used the model to evaluate how various regulations on animal production affected economic efficiency, and found that the externalities associated with animal production (e.g., water and air pollution) result in too many large facilities from a social welfare perspective that are also inefficiently large. Another finding

is that regulations that focus only on waste handling result in inefficiencies in spatial production arrangements. A solution to improve economic efficiency involves regulating both livestock facility sizes and entry. Innes contended that when the government cannot directly regulate manure application, producers will always choose to spread more manure nutrients to nearby cropland than crops can use. In this instance, regulating observable producer choices that affect manure-spreading practices might enhance economic efficiency.

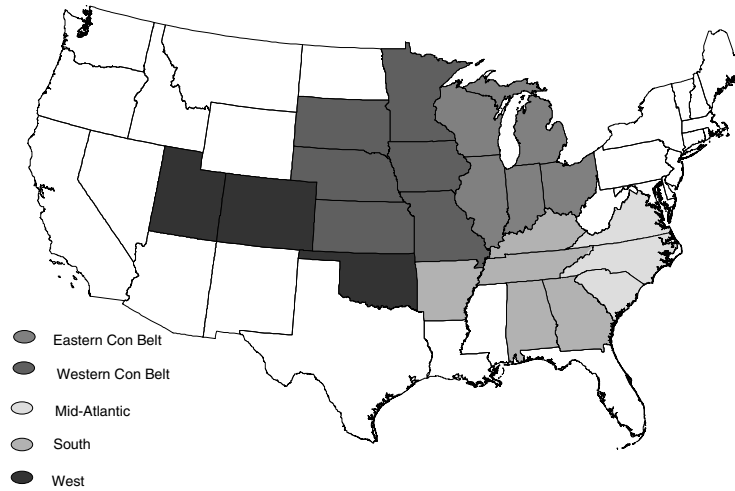
Estimating the Costs of Meeting Nutrient Standards

We used a simulation model developed by Fleming, Babcock, and Wang (hereafter referred to as the Fleming model) to estimate the net cost of meeting a nutrient application standard. The model uses costs of hauling and applying manure, fertilizer prices, number of head on the farm, type of manure storage system, crop mix of receiving land, local land use, and assumptions about landowner willingness-to-accept manure (WTAM), to estimate the net hauling and applications costs of meeting a nutrient application standard (Ribaudo et al.). Given a nutrient application rate, the model estimates the amount of land needed for spreading and the distance required to reach this land, taking into account the availability of land for spreading manure. We estimated a more complete cost of meeting a standard by adding the costs of developing and implementing a nutrient management plan (recordkeeping, soil testing, manure testing, and plan development) to the Fleming model. The costs of all farms meeting a nitrogen standard and a phosphorus standard were estimated, since we could not determine which type of standard each farm would have to meet.

We used data from the 1998 Agricultural Resource Management Survey (ARMS) to obtain farm-level data on operation size, manure storage technology, manure application technology, land used for spreading manure, cropland base, and crop yields for farms with confined hogs. The ARMS survey obtained more than 1,600 responses from 22 states. The survey target population was limited to farms with 25 or more hogs at any time during the year. The survey sample represents about 95% of the U.S. hog inventory in 1998. We identified five multistate regions of hog production based on similar production systems, geographic continuity, and sample size (Eastern Cornbelt, Western Cornbelt, mid-Atlantic, South, and West) (figure 1). We looked at three size classes based on EPA's definition of animal units (where one AU is 2.5 hogs weighing more than 55 pounds): small (<300 AU), medium (300–1,000 AU), and large (>1,000 AU). Large operations are CAFOs under the new Clean Water Act regulations, and must meet nutrient application standards.

Calculating the maximum permissible nutrient application rate for each farm starts with the nutrients contained in the harvested portion of the crops grown. The amount of a nutrient, nitrogen (N) or phosphorus (P), removed by harvest for each of 24 crops was calculated using an average nutrient content per unit of crop output and the crop production level, as outlined in Kellogg et al. The amount of P removed by harvest becomes the on-farm P application standard that hog producers are assumed to meet. To account for unavoidable losses in the soil that make some nitrogen unavailable to plants, a "nutrient recommendation" was calculated by multiplying nitrogen removed in harvest by 1.43 (Kellogg et al.). This becomes the on-farm N application standard.

Figure 1. Hog production regions



The recoverable manure nutrients (nutrients available after manure collection and storage) generated on the farm were estimated using procedures outlined in Kellogg et al. Recoverable nutrients divided by the maximum nutrient application rate (for N and for P) determined the amount of land needed for spreading manure under an N-based standard and a P-based standard. Even though the survey data are for hog farms, they include information on other types of animals raised on the farm as well. A nutrient standard will apply to all the manure on the farm, not just from hogs, so we made our calculations using the total amount of manure generated on the farm, and then allocated the costs to hogs based on the percentage of manure from hog production.

When land requirements were compared with land available on the farm, we found that many large farms did not have enough land to meet a nutrient standard and would need to move manure off the farm. Eighty-two percent of large operations did not have enough land to meet an N standard, and 96% did not have enough land to meet a P standard (Ribaudo et al.).

An important factor in the Fleming model for determining how far manure must be moved to reach enough suitable land is the willingness of crop operators to accept manure. The less the WTAM, the smaller the available land base and the further manure must be hauled. Not much is known about the demand for manure nutrients by crop producers who do not raise animals. Demand is not simply a function of the nutrient value. There are several potential drawbacks to land application of manure that could discourage use on cropland by farmers not raising animals. These factors include uncertainty associated with manure nutrient content and availability, high transportation, and handling costs relative to commercial fertilizer, soil compaction from spreading equipment, dispersion of weed seeds, concerns for added regulatory oversight, and public perception regarding odor and pathogen issues (Risse et al.). Also, it is unlikely that an animal operator with cropland would accept manure from another farm. In 1998, crop operators supplemented commercial fertilizer with manure as part of their

crop fertilization regime on approximately 17% of corn acreage and between 2% and 9% of soybean acreage (USDA, ERS 2000). While this does not necessarily represent willingness to accept, it provides a baseline assumption of the percentage of cropland "willing" to accept manure. We estimated costs with WTAM at 10% and 80% to bracket potential outcomes.

To estimate the costs of meeting a nutrient standard, we first estimated a baseline net cost of spreading manure with the Fleming model, using the acreage reported in the survey as actually receiving manure. Baseline costs consisted only of hauling and application costs. We assumed that all fields on a farm are in a unified block with the production facility in the center, for the purpose of estimating hauling distance. Fertilizer offsets are considered a benefit in the Fleming model and subtracted from hauling and application costs. Commercial fertilizer prices were used to value manure nutrients. However, nutrient applications in excess of crop needs were given a value of 0, since they do not contribute to yields.

We then estimated the net cost of applying manure to the land required by an N- or P-based standard. Manure was assumed to be spread on the farm first (where WTAM is assumed to be 100%), then to spreadable land off the farm. As in Fleming, Babcock, and Wang, the percentage of land off the farm suitable for receiving manure is the product of percentage of land in agricultural uses, percentage of agriculture land in pasture and manure-receiving crops (we assumed fruits and vegetables did not receive manure), and WTAM. Data on acreage in various land uses for counties containing confined hog farms were obtained from the 1997 National Resources Inventory. We assumed that the hog operator pays all the costs associated with moving manure off the farm: soil testing for receiving acres, transportation, and application. The difference between the cost of spreading on required acreage and net cost of spreading on baseline acreage is the cost of meeting the nutrient standard, without offsets. Our analysis does not consider the costs that may be incurred by changing manure handling technology, storage, labor, or other organizational factors that could be taken to meet a nutrient standard.

Estimating Cost Offsets

The fertilizer offset is realized when cropland not receiving manure in the baseline receives manure after the nutrient plan is implemented. We assume that cropland receiving manure had been receiving recommended levels of commercial fertilizer, and that manure nutrients would replace commercial fertilizer on a 1 for 1 basis. For manure moved off the farm, we assumed that the hog operator received a payment from the cropland operator equal to the nutrient value of the manure (equivalent to the costs of the commercial fertilizer being replaced). No benefit was given for manure nutrients applied in excess of crop needs. It is possible that crop producers would receive manure for free. If so, they would receive a windfall offset that we are accrediting to the manure producer.

The second offset involves financial assistance from EQIP. Per acre EQIP payments for Nutrient Management and Waste Utilization, and cost-share rates for Manure Transfer were obtained from 1997 to 2000 EQIP program data (table 1). Average payments for Nutrient Management ranged from $4.35 to $11.51 per acre across survey states. Average per acre payments for waste utilization range from

Table 1. Mean EQIP payments for nutrient management and waste utilization, by state, 1997–2000

State	Nutrient Management ($/acre)	Waste Utilization ($/acre)
Alabama	9.64	7.96
Arkansas	4.73	9.10
Colorado	8.67	7.25
Georgia	4.35	4.83
Illinois	7.32	5.50
Indiana	7.32	5.50
Iowa	7.32	5.50
Kansas	5.43	6.39
Kentucky	9.82	10.60
Michigan	4.35	4.83
Minnesota	4.35	4.83
Missouri	7.32	5.50
Nebraska	5.43	6.39
North Carolina	9.82	10.60
Ohio	7.32	5.50
Oklahoma	11.51	7.25
South Carolina	9.64	7.96
South Dakota	5.43	6.39
Tennessee	9.82	10.60
Utah	8.67	7.25
Virginia	9.82	10.60
Wisconsin	4.35	4.83

Source: 1997–2000 EQIP program data.

$4.83 to $10.60 per acre. Farm-level payment calculations for these practices were based on acres of land on the hog farm receiving manure, and not on land off the farm receiving manure. Manure transfer costs shares were assumed to be 50% of the cost of hauling manure on and off the farm. We assumed that all hog operators would receive the maximum EQIP payment for which they are eligible. We limited annual payments to each farm to $90,000 in order to model the five-year program maximum of $450,000 specified in the 2002 Farm Act. Farms receiving manure may also receive EQIP payments, but these were not considered in the analysis.

Results

Looking first at meeting a nitrogen-based standard with a WTAM of 10%, costs ranged widely between regions within similar size classes. Differences in costs reflect the amount of land available on the farm for spreading manure, and the percentage of cropland off the farm that can be used for spreading. Crop production is generally more integrated with animal production in the Corn Belt, so there is more land per animal available on the farm than in other regions. Consequently, less manure has to be moved off the farm. When manure must be moved off the farm, there is more land available in the Corn Belt than in other regions, resulting

in smaller hauling distances. For example, 78% of the total land in counties containing hog farms in the Corn Belt regions was suitable for receiving manure, while only 20% was suitable in the mid-Atlantic. In the case of large farms, cost differences between the Corn Belt regions and the mid-Atlantic and West also reflect the fact that large farms in the latter two regions tend to be larger, meaning that more manure must be handled and disposed. Small farms have similar costs across regions, except in the West, where costs are higher. Medium farms show regional variations similar to the large farms.

Fertilizer offsets can cover a substantial portion of the costs of meeting nutrient standards for large farms in the Eastern and Western Corn Belt regions (table 2). Larger amounts of manure moved off the farm and the cost of longer hauling distances greatly outweighed the fertilizer offset in the mid-Atlantic, South, and West.

Fertilizer offsets covered the cost of medium farms in the Corn Belt regions. While most of these farms must increase the amount of land for spreading manure in order to meet the nitrogen standard, they generally did not have to haul manure off the farm. Medium farms in the other regions had to move more manure off the farm, incurring higher hauling costs. Small farms in all regions but the West were generally meeting the nitrogen standard in the baseline scenario, so there is little fertilizer offset potential to cover the "fixed" costs of implementing a nutrient plan (plan development, testing, and recordkeeping).

Hauling and application costs make up less than 12% of total costs on farms where relatively little manure has to be moved off the farm (small farms in all regions but the West and medium farms in the Corn Belt regions) (table 3). Costs of plan development, testing, and recordkeeping are relatively more important on these farms. Hauling and application costs are much higher for large farms, which generally must move large amounts of manure off the farm in order to meet a nitrogen standard. Large farms in the mid-Atlantic, South, and West have relatively less land than their counterparts in the Corn Belt regions, and a smaller percentage of land off the farm is available for spreading, so hauling and application costs are higher in these regions.

Comparing net cost of meeting the nitrogen application standard (cost minus fertilizer offset) with total baseline production costs (variable costs and allocated overhead) gives some indication of the impact of the standard on a farm's economic performance (figure 2). Shown as a percentage of production costs, increased costs from meeting the nitrogen standard were insignificant in the Corn Belt regions, for all size classes, and for medium and small size classes in the other regions (near 0%). Costs increase by 2% to 3% for large farms in the mid-Atlantic, South, and West, even with the fertilizer offset. Additional offsets through financial assistance would be most important for these farms.

Requiring a more stringent phosphorus-based standard increases the costs for most farms (table 2). With lower manure application rates, a larger land base is needed for spreading. The result is generally more manure moving off the farm. Costs increase most for large farms, where the average cost is double that of the N standard in the mid-Atlantic, South, and West, and three times greater in the Corn Belt regions. Fertilizer offsets are also higher because no manure nutrients are applied in excess (unlike under an N-based standard, where P is usually in excess). Hauling and application costs are a much higher percentage of total

Table 2. Costs of meeting a nutrient standard assuming a WTAM of 10% and potential offsets, by operation size and region

	N-Based Standard				P-Based Standard			
Region and Size (AU)	Cost of Meeting a Nutrient Standard	Fertilizer Offset	Potential EQIP Payment	Potential Net Cost	Cost of Meeting a Nutrient Standard	Fertilizer Offset	Potential EQIP Payment	Potential Net Cost
Eastern Corn Belt								
<300	486	268	1,351	−1,133	708	632	2,214	−2,138
300–1000	925	1,856	4,730	−5,661	2,560	2,879	7,798	−8,117
>1,000	7,739	7,490	18,612	−18,363	25,148	10,338	27,177	−12,367
Western Corn Belt								
<300	479	218	1,469	−1,208	720	697	2,499	−2,476
300–1,000	761	1,348	4,564	−5,151	2,505	2,490	7,357	−7,342
>1,000	8,836	7,041	22,008	−20,213	24,770	9,998	30,883	−16,111
Mid-Atlantic								
<300	613	279	1,393	−1,059	750	279	2,022	−1,551
300–1,000	3,342	1,246	8,859	−6,763	6,819	1,716	11,144	−6,041
>1,000	45,391	7,037	42,409	−4,055	91,871	8,301	52,216	31,354
South								
<300	509	235	1,728	−1,454	736	311	2,407	−1,982
300–1,000	2,106	1,290	7,630	−6,814	4,327	1,644	10,546	−7,863
>1,000	28,766	3,889	34,473	−9,596	43,229	5,112	38,310	−193
West								
<300	2,606	1,091	4,048	−2,533	2,767	1,263	4,747	−3,243
300–1,000	2,903	901	7,780	−5,778	3,828	1,109	8,272	−5,553
>1,000	119,960	11,980	40,191	67,789	235,515	12,587	51,583	171,345

Eastern Corn Belt includes IL, IN, MI, OH, WI.
Western Corn Belt includes IA, KS, MN, MO, NE, SD.
Mid-Atlantic includes NC, SC, VA.
South includes AL, AR, GA, KY, TN.
West includes CO, OK, UT.

Table 3. Hauling and application costs as a percentage of total costs of meeting a nutrient standard by WTAM and nutrient standard

	WTAM = 10%		WTAM = 80%	
Region and Size (AU)	**N-Standard**	**P-Standard**	**N-Standard**	**P-Standard**
Eastern Corn Belt				
<300	2	18	0	3
300–1000	12	37	1	16
>1,000	43	81	10	56
Western Corn Belt				
<300	2	16	0	5
300–1,000	10	40	1	14
>1,000	43	78	16	62
Mid-Atlantic				
<300	11	16	2	7
300–1,000	56	80	11	32
>1,000	77	96	48	79
South				
<300	6	17	1	4
300–1,000	31	53	9	22
>1,000	66	83	54	70
West				
<300	42	48	23	25
300–1,000	67	79	8	6
>1,000	73	98	48	90

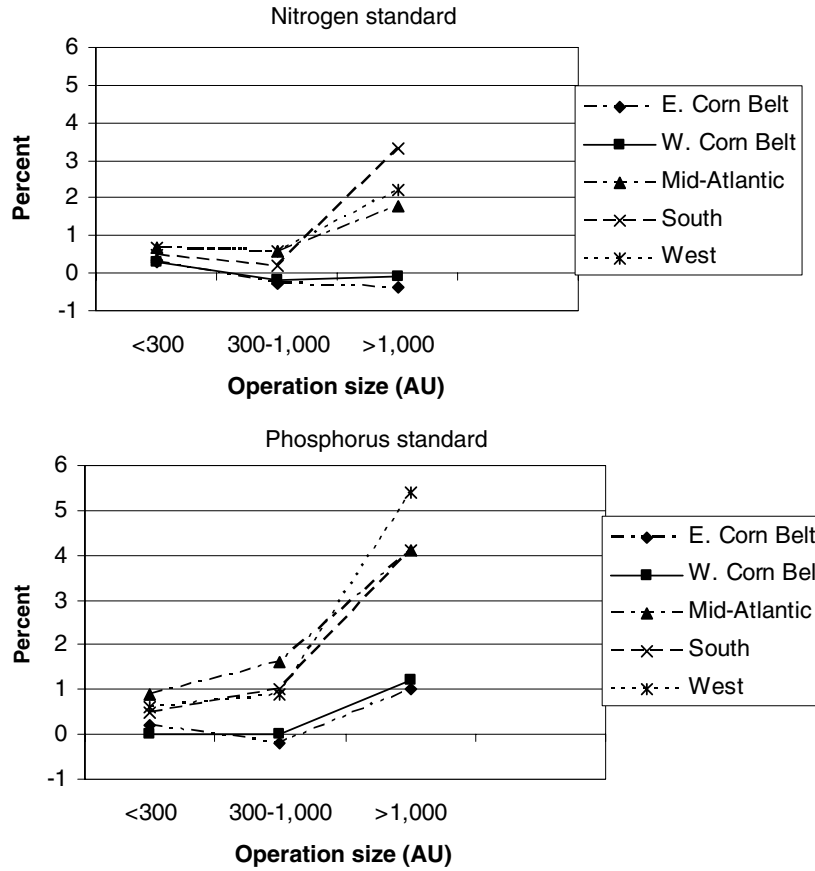
Eastern Corn Belt includes IL, IN, MI, OH, WI.
Western Corn Belt includes IA, KS, MN, MO, NE, SD.
Mid-Atlantic includes NC, SC, VA.
South includes AL, AR, GA, KY, TN.
West includes CO, OK, UT.

costs, approaching 100% for large farms in the mid-Atlantic and West (table 3). As a percentage of production costs, net costs of meeting a P-based standard are between 4% and 5.5% of production costs for large farms in the mid-Atlantic, South, and West. Despite higher costs than under the N standard in Corn Belt regions, the cost of meeting a P standard is still only about 1% of production costs.

Financial assistance from EQIP is a significant economic benefit to animal operations that receive it. Estimated payments more than cover the full costs of meeting the nitrogen standard for most farms, even without the fertilizer offset. There are two reasons for this. One is that the cost of meeting the standard is calculated as the change in cost from the baseline costs, while EQIP payments are based on total manure spreading and handling costs, including those on baseline acres. Second, payments for Nutrient Management and Waste Utilization are incentive payments, which are not based on costs (as a cost-share payment would be).

Only large farms in the West would realize higher costs after the fertilizer and EQIP offsets. The payment cap of $90,000 was most limiting for large farms in this

Figure 2. Costs of meeting nutrient standard as percentage of production costs, by size class and region, assuming WTAM of 10%



region. Annual EQIP payments for large farms ranged from over $18,000 in the Eastern Corn Belt to over $40,000 in the mid-Atlantic and West. Average payments are smaller for large farms in the Corn Belt regions because of the lower hauling costs and lower EQIP payment rates (table 1).

Because of the higher land requirements and longer hauling distances, potential EQIP payments are about 40% greater under the P-based standard than under the N standard. Fertilizer and EQIP offsets are again able to cover the costs of meeting a P standard for most farms. Exceptions are large farms in the mid-Atlantic and West. These farms would face large increases in production costs, even with the fertilizer and EQIP offsets.

WTAM has important implications for the costs of meeting a nutrient application standard. A higher WTAM reduces the cost of moving manure off the farm by reducing the distance that must be traveled to reach spreadable land (table 4). Increasing WTAM from 10% to 80% reduces the cost of meeting a nitrogen standard significantly for most operations, particularly large ones. For example, costs on large farms in the mid-Atlantic are 70% lower if WTAM is 80% rather

Table 4. Costs of meeting a nutrient standard assuming a WTAM of 80%, and potential offsets, by operation size and region

	N-Based Standard				P-Based Standard			
Region and Size (AU)	Cost of Meeting a Nutrient Standard	Fertilizer Offset	EQIP Payment	Potential Net Cost	Cost of Meeting a Nutrient Standard	Fertilizer Offset	EQIP Payment	Potential Net Cost
Eastern Corn Belt								
<300	477	268	1,347	−1,138	513	632	2,116	−2,235
300–1000	580	1,856	4,557	−5,833	892	2,879	6,964	−8,951
>1,000	1,830	7,490	17,130	−22,790	6,779	10,338	22,171	−25,730
Western Corn Belt								
<300	457	218	1,458	−1,219	500	697	2,389	−2,586
300–1,000	545	1,348	4,456	−5,259	822	2,490	6,516	−8,184
>1,000	1,844	7,041	20,042	−25,239	5,832	9,998	24,013	−28,179
Mid-Atlantic								
<300	480	279	1,326	−1,125	523	279	1,908	−1,664
300–1,000	779	1,246	7,577	−8,044	1,445	1,716	8,457	−8,728
>1,000	10,783	7,037	33,861	−30,115	26,340	8,301	39,242	−21,203
South								
<300	381	235	1,664	−1,518	414	311	2,246	−2,143
300–1,000	726	1,290	6,940	−7,504	1,219	1,644	9,064	−9,489
>1,000	7,917	3,889	26,842	−22,814	11,632	5,113	28,362	−21,843
West								
<300	926	1,091	3,208	−3,373	888	1,263	3,808	−4,183
300–1,000	679	901	6,668	−6,890	639	1,110	6,677	−7,148
>1,000	33,971	11,980	33,256	−11,265	73,483	12,587	36,888	24,008

Eastern Corn Belt includes IL, IN, MI, OH, WI.
Western Corn Belt includes IA, KS, MN, MO, NE, SD.
Mid-Atlantic includes NC, SC, VA.
South includes AL, AR, GA, KY, TN.
West includes CO, OK, UT.
WTAM = willingness-to-accept manure, measured as the percentage of cropland off the farm that is made available for spreading manure by crop operators.

than 10%. Hauling and application costs as a percentage of total costs for meeting a nitrogen standard drop considerably for most farms. However, hauling costs still account for a substantial portion of costs when meeting a P-based standard for large farms. A higher WTAM makes no difference in costs for farms that does not have to move manure off the farm, primarily small farms in the Eastern and Western Corn Belt regions. Potential EQIP payments are reduced about 10% overall because of lower hauling costs (acreage-based payments are unaffected since acres receiving manure remain the same).

Implications for EQIP

Meeting nutrient application standards increases the production costs of CAFOs, particularly in regions where land for spreading manure is relatively scarce on and off the farm. Fertilizer offsets mitigate some of these costs. Some operations, such as medium-sized farms in the Corn Belt regions, could benefit from meeting either an N-based or P-based standard without any financial assistance from EQIP, particularly if WTAM is high (ignoring other potential manure management costs not considered in the analysis). On the other hand, large farms in regions other than the Corn Belt would depend heavily on EQIP to defray cost increases. EQIP contracts for nutrient management are generally for 4 years. Some farms might need to consider additional adjustments in production practices, changes in farm size, or relocation to a low-cost region if EQIP payments end or if budget considerations greatly reduce potential payment rates.

EQIP is the major conservation program for working farms. What percent of the EQIP budget might CAFOs demand to meet the CAFO regulations and USDA goals? Our survey sample represented 4,700 farms considered CAFOs (>1,000 animal units) and 30,246 smaller AFOs. (EPA estimated about 4,000 large hog CAFOs nationally, based on 1998 Census of Agriculture data (U.S. Environmental Protection Agency, 2003).) If we assume that only large farms meet the CAFO regulations, the total potential annual EQIP outlays would range between $148 million (N-based plans) and $197 million (P-based plans) if WTAM is 10%, and between $127 million and $151 million if WTAM was 80%. These are within the 60% EQIP earmark for AFOs of $240 million in 2002, and all future authorizations. However, all other CAFOs in the other animal sectors could also be seeking EQIP funds. EPA estimates there are about 11,000 nonhog CAFOs (U.S. Environmental Protection Agency). If each of these has needs similar to hog operations, the existing EQIP budget would be exceeded by the potential demand from CAFOs in the near term, let alone demand from smaller AFOs voluntarily adopting nutrient management. If the EQIP budget reaches $1.3 billion as proposed, then all CAFOs could be funded within the 60% earmark ($780 million).

This analysis does not consider potential changes in hog production and prices that might result from increased production costs. If higher manure management costs reduce hog production and increase prices, less financial assistance from EQIP might be needed to cover the higher production costs because of price offsets. In aggregate, total demand for EQIP in the hog sector might also be reduced due to fewer farms remaining in production, or potential shifts to regions (such as the Corn Belt) where manure management costs are lower.

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Endnote

[1]USDA surveys do not account for non-harvested crops. In some regions of the country, hog farms plant Bermuda hay and other high nitrogen-using plants on fields receiving lagoon waste. We underestimated nitrogen uptake in these areas, particularly the Mid-Atlantic.

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