Impact Calculations For A Hog Concentrated Animal Feeding Operation

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Calculations Of Spreadable Acreage Requirements Based on Nitrogen

Total N/head[1]:

Gestating Sow: .0421 lb/head/day (169 days) (2 cycles) number of sows
=14.22 lb/sow/year.

Farrow Sow w/litter: .1318 lb/head/day(14 days)(2 cycles)(number of sows)
= 3.69 lb/sow/year.

Nursery Pig: .0162 lb/head/day (42 days)(2 cycles) (10) (number of sows)
= 13.61 lb/sow/year.

Finish Pig: .0588 lb/head/day (120 days) (2 cycles) (10) (number of sows)
= 141.12 lb/sow/year.

Total = 172.64 pounds of nitrogen per sow f-to-f per year.

Assume an average application rate of 50 lb/acre

Then 1 sow f-to-f needs 172.64/50 = 3.45 acres to spread the waste at agronomic uptake rates and 7200 sows f-to-f would require 24,860 acres.

[1] Source for nitrogen excreted per head: Nitrogen Estimate, Agri-Waste Technology, for Midwest Farms, LLC, Disk MWF 3, May 1, 1997.

Calculations Of Spreadable Acreage Requirements Based on Phosphorus

Hog waste, especially sludge from the bottom of pits and lagoons, is typically phosphorus enriched relative to crop needs. The ratio of available nitrogen to phosphorus from hog manure can be up to 1.5:1, whereas corresponding requirements for corn grain is about 6:1.[2] Similar studies in Colorado yielded a nitrogen/phosphorus ratio of 5:1 for corn in Yuma County, Colorado.[3] Further, "... Ohio has recently changed its recommendations, so that wastes are spread according to the phosphorus, rather than the nitrogen needs of the crop. Thus, more crop land is needed for disposal."[4]

Given that ratios that can be up to 1.5 to 1, nitrogen to phosphorus, assume a more conservative ratio of 2 to 1.

Total P/head

Gestating Sow: .0211 lb/head/day (169 days) (2 cycles) number of sows
=7.11 lb/sow/year.
Farrow Sow w/litter: ..0659 lb/head/day(14 days)(2 cycles)(number of sows)
= 1.85 lb/sow/year.
Nursery Pig: .0081 lb/head/day (42 days)(2 cycles) (10) (number of sows)
= 6.80 lb/sow/year.
Finish Pig: .0294 lb/head/day (120 days) (2 cycles) (10) (number of sows)
= 70.56 lb/sow/year.

Total = 86.32 pounds of phosphorus per sow f-to-f per year.

Nitrogen to phosphorus requirements are from 5 to 6:1 for corn.

Phosphorus requirements of about 27-33 pounds per acre were confirmed in actual crop tests by Al-Kaisi and Waskom.[5]

This is also substantiated by a University of Pennsylvania publication that shows that even at rates of 40 lb/acre/year, phosphorus buildup in the first five inches of soil can approximate 75 ppm after 10 years. This can be compared with agronomic thresholds of 20 to 50 ppm in the states of Arkansas, Delaware, Ohio, Oklahoma, Michigan, Texas, and Wisconsin. In fact, for concentrations of more than 75 ppm, phosphorus application should be discontinued in most of these states.[6]

At the application rate of 27 pounds per acre:

1 sow farrow-to-finish needs: 86.32/27 = 3.2 acres for the phosphorus it and its 20 piglets excrete over the course of a year. For 7200 sows this would equate to about 23,000 acres.

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[2] Pennsylvania State University, The Agronomy Guide 1995-1996, College of Agricultural Sciences, The Pennsylvania State University, University Park. PA, 1994.
[3] Al-Kaisi, Mahdi, and Waskom, Reagan, Summary Report: Swine Effluent Study 1995-1997, Department of Soil and Crop Sciences, Colorado State University, 1998, p.5.
[4] Understanding the Impacts of Large-Scale Swine Production, Proceedings from an Interdiciplinary Scientific Workshop, Des Moines, IA, June 29-30, 1995, p. 30.
[5] Al-Kaisi, Mahdi, and Waskom, Reagan, Summary Report: Swine Effluent Study 1995-1997, Department of Soil and Crop Sciences, Colorado State University, 1998, p.5.
[6] Managing Phosporus for Agriculture and the Environment, Penn State, College of Agricultural Sciences, Cooperative Extension, 1999, p. 4, 12.

Odor Control Costs Through Lagoon Coverage
(Note: All Costs are in 1998 US Dollars)

Source: McGregor, Dr. F. Robert, P.E., "Engineering Analysis of Costs for Compliance with Statewide Initiative 1997-1998 #113 to Regulate Housed Commercial Swine Feeding Operations," Water and Waste Engineering, Inc., 621 Seventeenth St., Suite 1020, Denver, CO, May 28, 1998, p. 2.

For an 800,000 pound inventory, assuming 250# for finishers and 450# for sows:
450X + 250(10X) = 800,000#
= about 300 sows farrow-to-finish or 6000 hogs per year throughput
For an 1,500,000 pound inventory, assuming 250# for finishers and 450# for sows:
450X + 250(10X) = 1,500,000#
= about 550 sows farrow-to-finish or 11,000 hogs per year throughput
Then, costs of compliance as a percentage of overall costs would be

	6000 hog	11,000 hog
Capital Costs	Inventory	Inventory
Cost for Compliance	$176,700-290,700	$244,500-449,500
Overall Facility Cost	$4.5mm-$5.8mm	$7mm-$9mm
Compliance Cost as %		
of Overall Cost	3.1%-6.5%	2.7%-6.4%
Annual Costs Amortized over a 10 year lifespan		
	.3%-.65%	.3%-.6%
Cost per hog over 10 years	$2.95-$4.85	$2.22-$4.08

	6000 hog	11,000 hog
Annual Costs	Inventory	Inventory
Cost for Compliance	$22,000	$35,600
Annual Facility Revenue	$.8mm-1.2mm	$1.5mm-2.0mm
Compliance Cost as %		
of Overall Revenue	1.8%-2.8%	1.8%-2.4%
Cost per hog	$3.67	$3.23

For a 81,000 hog operation, costs would probably be about $3.00 per hog in 1998 US dollars.

Note: The largest operating cost is for financial assurance to protect surrounding property in the event the industrial hog operation goes out of business without properly cleaning up. This amounts to $8,000 for the 6000 hog setup and $12,000 for the 11,000 hog setup.[7]

"The capital costs for compliance fall in the range of 2.7% to 6.5% of the overall capital cost for the facility. The low range cost for compliance will be for new systems that include the appropriate design features from the outset. The high range cost for compliance will likely apply to existing operations that must retrofit their anaerobic lagoons for odor control. The operating costs for compliance would be in the range of 1.8% to 2.8% of the total annual revenues."[8]

[7] McGregor, Dr. F. Robert, P.E., "Engineering Analysis of Costs for Compliance with Statewide Initiative 1997-1998 #113 to Regulate Housed Commercial Swine Feeding Operations," Water and Waste Engineering, Inc., 621 Seventeenth St., Suite 1020, Denver, CO, May 28, 1998, p. 5.
[8] McGregor, Dr. F. Robert, P.E., "Engineering Analysis of Costs for Compliance with Statewide Initiative 1997-1998 #113 to Regulate Housed Commercial Swine Feeding Operations," Water and Waste Engineering, Inc., 621 Seventeenth St., Suite 1020, Denver, CO, May 28, 1998, p. 2.

The Use of Water In Large CAFO Operations

"Water use in a hog confinement system is related to the actual water consumption of the hogs, plus the amount of fresh water used to clean the facility and flush the gutters, plus any fresh water used to help refill the lagoons after occasional sludge removal. Finishing hogs drink three to four gallons per day. Facilities that use fresh water to flush the gutters in hog facilities may use an additional 15 gallons per finishing hog or 35 gallons per sow and litter per day." [9]

"The choice to use recycled lagoon water versus fresh water is driven partly by the ratio of rainfall to evaporation, and availability of water. Lagoons must be kept filled to a certain level to maintain their treatment and efficiency...In dry climates where evaporation exceeds rainfall, fresh water must be added to lagoons to counteract evaporation." [10]

Drinking Water

Total drinking water consumption/head/year:(Source of figures:[11] and [12])

Gestating Sow: 5 gallons/head/day (169 days) (2 cycles) number of sows
= 1690 gals/sow/year.

Farrow Sow w/litter: 7 gallons/head/day(14 days)(2 cycles)(number of sows)
= 196 gals/sow/year.

Nursery Pig: 3 gallons/head/day (42 days)(2 cycles) (10) (number of sows)
= 2520 gals/sow/year.

Finish Pig: 4 gallons/head/day (120 days) (2 cycles) (10) (number of sows)
= 9600 gals/sow/year.

Total = 14,006 gallons of drinking water per sow f-to-f per year or 100,843,200 gallons per year for 7200 sows f-to-f.

38 gallons of drinking water per sow f-to-f per day or 276,282 gallons per day for 7200 sows f-to-f.

Flushing Water:

Total waste flushing water /head/year:(Source of flushing water figures[13] above and [14])

Gestating Sow: 15 gallons/head/day (169 days) (2 cycles) number of sows
= 5070 gals/sow/year.

Farrow Sow w/litter: 35 gallons/head/day(14 days)(2 cycles)(number of sows)
= 980 gals/sow/year.

Nursery Pig: 15 gallons/head/day (42 days)(2 cycles) (10) (number of sows)
= 12,600 gals/sow/year.

Finish Pig: 15 gallons/head/day (120 days) (2 cycles) (10) (number of sows)

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[9] Structures and Environment Handbook, 11th Edition, 2nd Revision, Midwest Plan Service, Iowa University, Ames, Iowa, 1987 in Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

[10] Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

[11] National Average data from Raftelis Environmental Consulting Group 1998 Water Survey based on 137 water systems (1997 data). and
1998 Fact Book, Colorado Springs Utilities, City of Colorado Springs, Colorado Springs, CO, June, 1998.

[12] Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

[13] National Average data from Raftelis Environmental Consulting Group 1998 Water Survey based on 137 water systems (1997 data). and
1998 Fact Book, Colorado Springs Utilities, City of Colorado Springs, Colorado Springs, CO, June, 1998.

[14] Donham, Kelley, and Thu, Kendall, "Introduction," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, p. 14.

= 36,000 gals/sow/year.

Total = 54,650 gallons of flushing water per sow f-to-f per year or 393,480,000 gallons per year for 7200 sows f-to-f.

150 gallons of flushing water per sow f-to-f per day or 1,078,027 gallons per year for 7200 sows f-to-f.

Total water use for 7200 sows f-to-f would be 1,354,309 gallons of drinking and flushing water per day or almost 500,000,000 gallons of water per year. Additional water may be required for lagoon management.

The Economic Effect of CAFO Production On Regional Economies

The four economic characteristics of a CAFO:

(1) The use of capital intensive production methods.
(2) Employment of a production methodology that maximizes the tax benefits.
(3) The use of vertically integrated operations.
(4) The use of cost shifting to reduce the costs of production.

are fundamentally incompatible with regional economic development. Regional economic development proceeds on the premise that the wages paid and purchases made by a company are transferred to other individuals or companies in the region. The multiplier effect of these payments further assumes that they are again spent within the confines of the region and that they do not "leak" into other areas of the state or nation. However CAFOs are structured so that they cannot aid regional economic development for the following reasons:

(1) Constraints on Regional Economic Development Due To Employment

As a capital intensive company, a CAFO is designed to minimize the number of workers and hence, minimize the economic impact on the region. A 1998 Colorado State University study found that only 3-4 direct jobs (jobs with the hog producer) are created for every 1000 sows in a CAFO sow farrowing operation.[15] Ikerd calculated that a farrow-to-finish contact hog operation would employ about 4.25 people to generate over $1.3 million in revenue. His figures showed that an independently operated hog farm would employ about 12.6 people to generate the same amount of hog sales.[16]

Depending on the state, the employment multiplier for agriculture varies from 1.8 to 2.2 for every direct employee (thus, indirect and induced impacts on related economic sectors of the economy would create 1.8 to 2.2 total jobs for each person employed in hog production.) However, if one treats CAFOs as industrial operations, the multiplier would be much lower--about 1.35.[17]

It is likely that even this figure overstates the economic impact on rural counties. For the employment multiplier to operate at the levels specified in the Department of Commerce RIMS II model, all employees must both live and work in the county. Given the ability to commute, it is likely that many workers will live well outside the region and that the actual employment multiplier will be further depressed.

The size of the employment multiplier further depends on amount of purchases a CAFO makes in the region. However, large scale animal production facilities are more likely to purchase their inputs from a great distance away, bypassing local providers in the process.[18] A 1994 study by the University of Minnesota Extension Service found that the percentage of local farm expenditures made by livestock farms fell sharply as size increased. Farms with a gross income of $100,000 made nearly 95% of their

[15] Park, Dooho, Lee, Kyu-Hee, and Seidl, Andrew, "Rural Communities and Animal Feeding Operations," Department of Agricultural and Resource Economics, Colorado State University, Ft. Collins, CO, 1988.
[16] Ikerd, John E., "Sustainable Agriculture: An Alternative Model for Future Pork Producers," in The Industrialization of Agriculture, Jeffrey S. Royer and Richard T. Rogers, eds., Ashgate Press, Brookfield, VT, 1998, pp. 281-283.
[17] RIMS II, Department of Commerce, Bureau of Economic Analysis, Washington, DC, October, 1997.
[18] Lawrence, John D., et al., "A Profile of the Iowa Pork Industry, Its Producers, and Implications for the Future," Staff Paper No. 253, Department Of Economics, Iowa State University, 1994.

expenditures locally while farms with gross incomes in excess of $900,000 spent less than 20% locally.[19]

Confined animal production can occasionally benefit local grain sellers, but only when it consumes all the grain produced in the county. If the county has to export even one bushel of grain, all the grain in the county will have to be priced at a lower level that will enable the grain to compete in the export market.[20]

(2) Constraints on Regional Economic Development Due To Taxes

Federal, state and local taxes are levied on taxable amounts calculated on federal returns. The numerous tax write-offs that are possible because CAFOs are sometimes treated as industries and, at other times, treated as farms, significantly decrease the amounts of taxes paid locally. At the same time the operations of the CAFO create social, health and traffic costs that the local government must finance. The local government, in turn, must rely on increased taxes to pay these CAFO-induced costs--and this can decrease other economic activity in the region.

For example, additional costs associated with hosting a CAFO include increased health costs, traffic, accidents, and repairs. One Iowa community estimated that its gravel costs alone increased by about 40% (about $20,000 per year) due to truck traffic to hog CAFOs with 45,000 finishing hogs. Annual estimated costs of a 20,000 head feedlot on local roadways were $6447 per mile due to truck traffic.[21] Colorado counties that have experienced increases in livestock operations have also reported increases in the costs of roads, but specific dollar values are not available. [22] In addition, an Iowa study found that while some agricultural land values increased due to an increased demand for "spreadable acreage," total assessed property value, including residential, fell in proximity to hog operations. [23]

(3) Constraints on Regional Economic Development Due To Vertical Integration

Vertical integration requires purchases from and sales to other members of the vertically integrated company, not from local producers and suppliers. Thus, vertically integrated companies stimulate regional economies only to the extent that all elements of the company are located in the region. Historically, this factor has severely limited the economic impact of CAFOs on the regions in which they are situated. For example, Lawrence found that in Iowa smaller hog operations (less than 700 head annually) purchased 69 percent of their feed within 10 miles of the operation. Large hog operations (2000 or more hogs per year) that are more likely to be vertically integrated only purchased 42 percent of their feed within 10 miles of the operation. [24]

(4) Constraints on Regional Economic Development Due To Cost Shifting

The previous three sections have described the reasons inherent in the structure of CAFOs that most of the money from a CAFO will either be directly spent outside the region or it will quickly migrate there. However, through cost shifting the CAFO will leave the costs of its odor, health risks, surface water pollution, ground water pollution and in the long run, its abandoned lagoons and facilities for the region to deal with. This directly effects both long and short run economic development.

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[19] Chism, John, and Levins, Richard, "Farm Spending and Local Selling: How Do They Match Up?," Minnesota Agricultural Economist, no. 676, University of Minnesota Extension Service, Spring, 1994.
[20] Hayes, Dermot, Iowa's Pork Industry--Dollars and Scents, Iowa State University, January, 1998.
[21] Duncan, M.R., Taylor, R.D., Saxowsky, D.M., and Koo, W.W., "Economic Feasibility of the Cattle Feeding Industry in the Northern Plains and Western Lakes States," Agricultural Economic Report No. 370, Department of Agricultural Economics, North Dakota State University, 1997.
[22] Park et al., op. cit.
[23] Ibid.
[24] Lawrence et al., op. cit.

Put bluntly, every company has many choices of location and active recruitment is practiced by most regions. Quality of life is a major factor in decisions to locate in a region, and most companies would never consider locating in an area where a CAFO is operating. In addition, CAFOs such as large hog farms adversely impact the value of neighboring property in the region.

Palmquist et al., in a 1995 study in North Carolina, found that neighboring property values were affected by large hog operations based on two factors: the existing hog density in the area and the distance from the facility. The maximum predicted decrease in real estate value of 7.1 percent occurred for houses within one-half mile of a new facility in a low hog farm density area. A 1997 update of this study found that home values decreased by $.43 for every additional hog in a five mile radius of the house. For example, there was a decrease of 4.75% (about $3000) of the value of residential property within 1/2 mile of a 2,400 head finishing operation where the mean housing price was $60,800. [25] A 1996 study by Padgett and Johnson found much larger decreases in home value than those forecast by Palmquist. In Iowa, hog CAFOs decreased the value of homes in a half-mile radius by 40%, within 1 mile by 30%, 1.5 miles by 20% and 2 miles by 10%.[26]

[25] Palmquist, R. B. et al., "The Effects of Environmental Impacts from Swine Operations on Surrounding Residential Property Values," Department of Economics, North Carolina State University, Raleigh, North Carolina, 1995.
[26] Park et al., op. cit.