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Potential Economic Impacts of the Revised Environmental Protection Agency "CAFO Rule"

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INTRODUCTION

An examination of hog and pig inventories in the United States will show that there has been a fairly steady increase in those numbers from 51 million head in 1986 to the recent peak of 62 million in 1998. Concurrent to this rise in hog and pig numbers, there has been a notable change in the structure of the swine industry. Recent years have brought significant changes in swine production technology and in the structure of the swine industry itself, reminiscent of the shifts experienced by the poultry industry beginning in the 1950's. As swine operations become more capital intensive and simultaneously strive for greater physical and economic efficiencies, the concentration of swine production continues to increase. In 1978, farms with more than 500 head of swine accounted for 43% of the U.S. hog and pig inventory; by 1997, they accounted for 87.4%. While these larger operations enjoy a number of improved efficiencies, they also pose potential environmental hazards unless properly managed.

Principal among these hazards are the large amounts of animal wastes generated. To dispose of the waste while also seeking to "recycle" the nitrogen, phosphorus, and organic material it contains, many producers employ open lagoons as storage structures for the waste until the application of the waste to cropland. While these procedures may lead to successful reuse of nutrients if performed correctly, they also may lead to nutrient runoff into surface waters or leaching into groundwater sources if performed improperly.

The changes in the swine industry and its potential environmental impacts prompted the EPA to take another look at the regulations governing the operation of concentrated animal feeding operations (CAFOs). Since the original CAFO regulations were promulgated pursuant to the Clean Water Act in 1972, EPA proposed significant changes to address the changes in production practices and to incorporate the enforcement experiences of the EPA under the present set of regulations; the new regulation is likely to become effective in early 2003. While the proposed new rule presents a host of changes, two are of particular relevance to the physical structure and waste management practices of swine production operations. These are the "zero-discharge" requirement, and the limitation of land application of wastes to the annual phosphorous need of the crop to which it is applied.

The zero-discharge requirement specifically alters an exception to the current CAFO regulations. Currently, many operations that house enough animals to be considered a CAFO do not technically need a CAFO permit if their waste storage structure will only discharge wastes under the conditions of a 25 year / 24 hour storm event. The new regulations do away with this exception, and further require all swine CAFOs to "achieve a zero discharge standard at all times," meaning that no discharges in violation of the operation's permit are allowed under any circumstances. As illustrated in this paper, this regulation may require significant changes to the design of CAFO waste management structures.

The annual phosphorus removal limitation constitutes a response to growing concerns over phosphorus impairment of many surface waters. Excess levels of phosphorus can lead to population explosions of algae and other organisms that, in turn, require that the waters be treated intensively for purposes of human consumption or use or, alternatively, abandoned. The new phosphorus limitation seeks to eliminate the possibility of excess phosphorus buildup in soils and thus eliminate the runoff of such excess phosphorus into surface waters. Under the limitation, CAFO operators would not be allowed to apply waste in amounts that would exceed the ability of the crop raised on that land to uptake and remove by means of that year's harvest. Since many farms now apply waste based on the nitrogen utilization capacity of the crop raised on the land, compliance with this regulation may also require significant changes in farm practices.

Given the imminence of the new regulation, it is important that both policy-makers and producers be aware of the possible firm-level impacts of the proposed regulatory changes, and that they understand the changes in both production practices and physical configurations of swine operations necessary to come into compliance with those regulatory changes. This project sought to fulfill the goal of increased stakeholder knowledge by pursuing two specific objectives.

1. Estimate the current cost of production, as represented by breakeven cost of live hogs sold to cover variable and fixed costs, for a given set of modeled swine production operations (these operations were located in the states of Oklahoma, North Carolina, and Iowa, for reasons stated below).
2. Estimate the new breakeven cost of live hogs sold under the conditions of the proposed regulatory changes and evaluate other economic impacts of operational modifications needed to come into compliance with the hypothesized regulations.

PROCEDURES

Location of Modeled Operations / Adjusting for Regional Costs

Since the resources available to conduct this project were limited, it was not practical to model a large number of swine operations across all United States swine production regions. Thus, three states were chosen to represent some of the varying production practices and conditions throughout the country. Iowa was chosen because of its traditional dominance in swine production; over the past 50 years, Iowa has accounted for an average of 24% of all swine production in the United States. Swine production is also the second largest segment of Iowa's agricultural sector (second only to corn). North Carolina was chosen because of its recent meteoric rise in swine population, growing from 2.8 million head in 1990 to 9.8 million in 2001, propelling hogs and pigs to the most important agricultural commodity in the state as measured by cash receipts. Oklahoma was selected for its similar recent expansion in swine inventory, growing over 800% from 1991 (the year legislation restricting corporate ownership of livestock operations in that state was repealed) to 1998. Finally, these three states were chosen because the cropping systems on areas receiving land-application of wastes in all areas were different, as were the waste storage and application practices.

To determine the basic characteristics of the modeled operations, the details of the agriculture sector in each modeled area were examined. The physical size, crop mix, and other operational characteristics of the modeled farms, as well as the costs of various operation inputs are detailed in Tables 1 and 2. These characteristics were then incorporated into the Swine Waste Management Program ("SWMP") and Missouri Swine Budget Generator (MSBG) programs developed by Oklahoma State University and the University of Missouri, respectively.

<u>The Missouri Swine Budget Generator</u>

The first of these models was an enterprise budget generator developed at the University of Missouri. Taking information provided by the user, the MSBG, (in the form of an array of Excel© worksheets) uses integrated information regarding physical, technical, and economic production relationships to estimate the production and costs of the specified operation.

Separate programs were constructed to model three types of swine production programs – a 600 sow farrow to feeder operation, a 1200 sow farrow to finish operation, and a 4000 head feeder operation. These operations represent what are believed to be common sizes for their respective enterprises. Even in those cases where a swine production operation chooses to operate at a larger scale, they are likely to choose an operation that represents a multiple of these operations' scales (2400 sow farrow to finish operations, 1200 sow farrow to feeder operations, etc.). For the purposes of this research, it was decided that a farrow-to finish, a farrow-to-feeder, and a finisher operation would best represent the spectrum of swine production operations in the modeled states, and that scales of 1200 sows at both the farrow-to-finish and farrow-to-feeder operations, and a 4000 head finisher operation would best approximate production practices (this dictated that the already-existing 600 sow farrow to feeder operation was modified for this increase in scale).

After supplying the program with throughput information, the user may input estimated annual average costs for a number of items involved in the farm's production operations. These cover the usual items found in an enterprise budget for swine production: feed costs, breeding costs, veterinary costs, utilities, labor, marketing costs, and so on. The user can also enter the total costs of buildings and equipment for the operation. Given this information the MSBG will then calculate the total annual costs of operation for the operation, and summarize them in the form of an enterprise budget that includes the costs on a per-head-sold or per-litter basis in the case of the farrow to feeder and farrow to finish operations, or a per-head-sold, or per hundred weight basis in the case of finisher operations.

The Swine Waste Management Program

The second model, the Swine Waste Management Program (SWMP), was created in a cooperative venture between Oklahoma State University and the University of Missouri, and calculates the estimated cost of swine waste management for a specified operation. The SWMP contains a great deal of integrated information regarding the specifications of a number of available waste storage, treatment, and application technologies. The user need only enter a few specifications about the swine "throughput" capacity of the operation under investigation, the physical arrangement of the operation, available cropland information, and the desired type of waste management system.

Using the information provided by the user, the SWMP then executes calculations to determine the exact configuration of the waste management system and its attendant costs. Specifically, the program determines the size of the waste storage facility needed to contain the wastes generated by the operation, given the number and type of swine (larger pigs will naturally generate a greater volume of waste per unit time than smaller pigs). The program also contains construction cost coefficients that enable it to determine the construction costs necessary for the storage facility (and, as a result, the depreciation costs for the facility).

In addition to calculations relating to the storage of animal wastes, the SWMP also determines the appropriate design characteristics of the operation's waste application system. The user may specify up to six different crops to receive the wastes; information regarding the crops would include the acres of each crop to be used, the distance from the swine operation to each field, and other field characteristics. The user must also specify a yield goal, which is important in allowing the program to calculate how much of the wastes can be used by the given crops.

The crop information provided, along with the data regarding the waste generated by the operation, allows the SWMP to calculate the dimensions of the land application system needed to handle the appropriate waste volume. While the user must specify the type of system to be used (for example, the user may select a center-pivot system, a drag-hose injection system, or a haul-tanker wagon), the program will calculate the capacity of the system in terms of the specific system chosen; in the example of a center-pivot system, this would include the needed volume per-unit-time capacity of the piping to the field, the size of pumps needed to transport the waste effluent from the operation to the field, etc.

The SWMP compiles the information regarding both the waste storage facilities and land-application systems to estimate an annual cost of waste management for the operation. In its system summary, the program presents the system dimensions and annual operating costs, along with the total capital investment in the system, as well as information on the depreciation of the system components.

Integrating the Models

The two models were manually integrated to estimate how the costs of waste management (under both the baseline conditions and the hypothesized regulations) would impact the overall costs of production for the operation. First, data regarding the costs of production for each modeled operation were accumulated. Then, the SWMP was used to calculate the costs of waste management for the operation. This cost was then prorated over each operation's capacity to estimate a line-item cost of waste management for the operation's enterprise budget. This information, combined with the previously mentioned production cost data, was then included in the inputs of the MSBG to calculate the costs of production for each operation, first under the baseline conditions, and then under the influence of the hypothesized regulations.

After arriving at the base-scenario cost structure for each operation, the proposed CAFO regulations were imposed on each operation (specifically, the zero-discharge requirement and annual phosphorus removal limitation), and the cost of waste management re-estimated for each scenario. The zero-discharge requirement was treated as, in essence, an elimination of open lagoons as a waste storage medium, and a requirement that land-applied waste be injected so as to reduce the possibility of nutrient runoff. Also, to estimate the costs of lagoon closure for the modeled operations, CAFO licensing applications submitted to the Oklahoma Department of Agriculture were examined (which, by Oklahoma law, must include provisions for a lagoon shutdown procedure), and an average cost of lagoon shutdown per unit of storage volume was calculated, then adapted to the respective modeled operations using the same regional construction cost indices employed to modify building costs for the operations.

The annual phosphorus removal limitation was similarly construed as a requirement to obtain more cropland to receive waste application, as it was assumed that there would be no other readily available means of reducing the phosphorus content of the waste or disposing of it altogether. Given the projected cost of waste management under the hypothesized regulations, a new breakeven cost will be calculated for each operation.

RESULTS

Summary of Impacts on Oklahoma Operations

Given the adjustments made to the basic enterprise budgets, the Oklahoma swine enterprises consistently had the second-lowest costs of production, with a farrow to feeder breakeven of $36.51 per head (see Table 3), a farrow to finish breakeven of $31.59 per hundredweight (see Table 4), and a finisher breakeven of $35.48 hundredweight (see Table 5). This can be attributed to relatively low costs of feed grains, labor, and utilities, as well as low construction cost coefficients. Oklahoma also consistently had the lowest cost of waste management per head, owing to all the modeled Oklahoma operations having smaller lagoons than their North Carolina counterparts, and the pre-existence of a land application system in the form of center-pivot irrigation systems.

Under the proposed regulations, the Oklahoma operations again consistently had the second lowest breakeven prices, at $36.89 per head for the farrow to finish operation (an increase of $0.38), $32.21 per hundredweight for the farrow to feeder operation (an increase of $0.62), and $35.84 for the finisher operation (an increase of $0.36).

The capital requirements of the Oklahoma operations under the baseline conditions were consistently the lowest of the examined operations, with a farrow to feeder investment of $137,365, farrow to finisher investment of $299,860, and finisher investment of $121,475. Under the proposed regulations, these operations had investments of $258,376, $588,447, and $226,379 – indicating a notable increase. This was due not only to the increased costs of new waste storage facilities, but also to the fact that the Oklahoma operations had to have a waste application system capable of handling a much larger crop area than the operations in North Carolina or Iowa. Mitigating this, though, was the fact that since the Oklahoma operations were no longer using lagoons, the water use by the operations dropped (since annual evaporation at the modeled Oklahoma operations' locations exceeded annual rainfall, fresh water actually had to be added to the lagoons to make them function properly). In addition to these investment costs, each of these operations would be required to conduct a lagoon shut-down, at a cost of $188,098 to the farrow to feeder, $571,143 to the farrow to finisher, and $166,354 to the finisher.

Under the hypothesized regulations, each Oklahoma production operation had an insufficient land base for the application of its wastes; however, each operation had the least waste remaining of its counterparts, and thus required less additional land for the complete application of all wastes. The Oklahoma farrow to feeder operation required 371 additional acres, the farrow to finisher operation required 1,916 acres, and the finisher required 294 acres.

Summary of Impacts on North Carolina Operations

In each of the baseline enterprise budgets, the North Carolina operations consistently had the highest breakeven price by fairly narrow margins, with a farrow to feeder breakeven of

$38.22 per head, a farrow to finish breakeven of $33.37 per hundredweight, and a finisher breakeven of $36.44 per hundredweight. This resulted in gaps of $2.20 per head, $2.66 per hundredweight, and $1.89 hundredweight, respectively, between North Carolina's operations and those of Iowa, the lowest-cost producer in each case. Under the baseline conditions, North Carolina also consistently had the second-highest costs of waste management, owing to the need for a larger lagoon than Oklahoma (in order to accommodate more rainfall than Oklahoma), but using less intensive technologies than Iowa.

In the alternative scenarios, the North Carolina operations remained the highest-cost producers for each operational type, with breakeven prices of $38.48 per head for the farrow to feeder (an increase of $0.26), $34.03 per hundredweight for the farrow to finish operation (an increase of $0.66), and a finisher breakeven of $36.72 (an increase of $0.28).

In the baseline scenarios, the North Carolina operations always had the second-lowest initial investment cost, given the fact that their lagoons were larger than those of their Oklahoma counterpart operations, and yet not as intensive as the Iowa operations' management systems. The initial investment for the farrow to feeder operation was $177,635, with investments of $357,372 for the farrow to finisher, and $162,424 for the farrow to feeder. Under the alternative scenarios, the investments for these operations were $253,704 for the farrow to feeder, $604,795 for the farrow to finisher, and $216,919. Each of these operations, as in Oklahoma, would also be required to shut down their lagoons, at estimated costs of $208,226 to the farrow to feeder, $651,496 to the farrow to finisher, and $185,076 for the finisher.

Given the fact that the North Carolina operation had the smallest crop base upon which waste could be applied, it had the most waste remaining after the capacity of the land had been fulfilled, and thus also required the most additional land in each alternative scenario. This was compounded by the fact that, while bermudagrass can use nitrogen very effectively, it has little phosphorus uptake potential. 494 additional acres were required for the farrow to feeder operation, 1,888 additional acres were required for the farrow to finisher, and the finisher needed another 604 acres.

Summary of Impacts on Iowa Operations

Each of the Iowa operations had the lowest breakeven price of production of the modeled operations under both baseline and alternative conditions, attributable to a distinct advantage in feed costs. In the baseline scenarios, this meant a farrow to feeder operation breakeven of $36.02 per head, a farrow to finish breakeven of $30.71 per hundredweight, and a finisher breakeven of $34.55 per hundredweight. Under alternative conditions, these breakevens were $36.09 per head, $30.76 per hundredweight, and $34.55 per hundredweight, respectively. The reader will note that these are fairly small changes.

The effects on initial system investment were also slight, and in a different direction than those of the other operations. Under the baseline conditions, the Iowa operations had comparative disadvantage in that the cement storage tanks were more expensive to construct than Oklahoma or North Carolina's lagoons; similarly, the haul-tanker waste application systems were much more labor-intensive than Oklahoma and North Carolina's irrigation systems. Nevertheless, under the proposed regulations, all three Iowa operations, all three modeled operations actually saw decreases in initial investment costs: $4,434 for the farrow to feeder, $13,755 for the farrow to finisher, and $1,091 for the finisher. This was due to a reduction in the demands on the tractors used for haul-tanker application, given the fact that application of wastes based on phosphorous levels occurred at different rates than application based on nitrogen. Thus, fewer horsepower-hours were required from the tractors.

The imposition of phosphorous limitations had dilatory effects on the Iowa operations as well, however (the reader may note that even before the imposition of this limitation, the Iowa farrow to finish operation had 87 acre-inches of waste remaining [see Table 4]). With this restriction, each Iowa operation was able to apply less than half their waste before meeting the phosphorous capacity of its crop base. The Iowa farrow to feeder operation would require an additional 554 acres of land; the farrow to finisher would require 2,357 more acres; and the finisher would need 465 additional acres to completely apply all the wastes generated by the swine enterprise.

Conclusions

The effects of the imposition of the hypothesized regulations can be viewed along three basic dimensions for each type of operation: the change in costs of production (expressed in this research as the breakeven price for each operation), the change in capital requirements, and the changes in land requirements.

The hypothetical regulations did not affect the relative positions of the states in regard to the cost of production; in both the baseline and alternative scenarios for every type of modeled operation, Iowa held the lowest-cost position, followed by Oklahoma and North Carolina. This being said, it must be noted that the hypothetical regulations did affect the margins between each operation. With the exception of the farrow to finisher operation, the regulations narrowed the difference in breakeven price between Oklahoma and North Carolina, and widened the gap between all three operations in Oklahoma and Iowa. The regulations also served to widen the gap between all three operations for North Carolina and Iowa.

The differential impacts between operations on the capital investment needed to come into compliance with the hypothesized regulations are significant. If one combines the cost of new waste management storage and application systems with the costs of lagoon closure, the farrow to feeder operations in Oklahoma and North Carolina would be required to spend roughly $450,000; the farrow to finish operations would have to spend approximately $1,200,000, and the finisher operations would need to spend nearly $400,000. However, as mentioned previously, the Iowa operations would actually see a decrease ranging from $1,091 for the finisher operation to $13,755 for the farrow to finisher.

Perhaps the most dramatic impacts can be seen in the change of crop bases needed by the modeled operations for the application of wastes. The smallest change was found in the case of the Oklahoma finisher operation, which would have to somehow acquire 294 additional acres of land to fully utilize the nutrients of the waste generated by its swine enterprise. The most pronounced difference was that of the North Carolina operation, which would need another 1,888 acres of cropland for it's waste – more than the entire land area of the Oklahoma operation and nearly sixteen times the size of the operation itself.

From these results, it can be seen that the implementation of the proposed regulations could demand either dramatic shifts in production practices in Oklahoma and North Carolina, while Iowa could see less dramatic effects. This in turn would lead to a shift in the relative competitiveness of swine producers among the examined regions; while there would not necessarily be a shift in the competitive position of the operations, there would likely be shifts in the gaps between the breakeven prices of the operations.

At the firm level, the need for additional capital to fund these changes in waste management technologies and systems could dictate shifts in the cost-sharing arrangements of contract producers, or require industry exit for some producers. For those producers that did maintain their operations, it would be necessary to somehow procure additional land for the application of wastes, either through the sale of nutrients to adjoining landowners or the shipment of such wastes to more distant operations. The proposed regulations might also increase the geographic dispersion of future operations (and might have a similar effect on existing operations, should industry-exit be a popular choice for producers).

While the predicted effects of the proposed CAFO rule vary from location to location, the fact that significant changes in swine production will be needed to comply with the new rule is constant among them all. Producers must start looking for ways to adapt now; else, the next major wave of structural change in the swine sector may not be initiated by market factors, but by regulations.

References

Author unknown. "Ingredient Market." *Feedstuffs,* March 27th, 2000, pp. 24-25.

Bill Barr and Co. Sales Staff, Lenexa, Kansas. Telephone interview by author, 13 April 2000.

DiPietre, Dennis, John Hoehne, Mark Newcomb, Rick Tubbs, Tim Safranski, and Joe Zulovich. *The Missouri System of Swine Production.* Commercial Agriculture Program Manual 144. University of Missouri, 1996.

Dougherty, Mark, Larry D. Geohring, and Peter Wright. *Liquid Manure Application Systems Design Manual.* Northeast Regional Agricultural Engineering Service, publication NRAES-89.

Ferrell, Shannon L. "The Potential Economic Impacts of Proposed Concentrated Animal Feeding Operations Regulations on the Swine/Pork Industry." Unpublished M.S. Thesis, Oklahoma State University, Stillwater, Oklahoma, 2001.

National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitations Guidelines and Standards for Concentrated Animal Feeding Operations, 66 Fed. Reg. 2960 (Jan. 12, 2001).

Massey, Ray, Joe Zulovich, John Haney, Missouri Swine Budget Generator. Excel© template. Commercial Agriculture Program, University of Missouri, 1998.

Massey, Ray, John Lory, Joseph Zulovich, et al., "Comments on the EPA Proposed Animal Feeding Operations Rule." Missouri Commercial Agriculture Extension Program, <http://agebb.missouri.edu/commag/CAFObrochure.pdf>, July 10, 2002.

Oklahoma State Department of Agriculture, Oklahoma Agricultural Statistics Service. *Oklahoma Agricultural Statistics 1998.* Oklahoma City, Oklahoma, 1999.

Prince Agri-Products Sales Staff, Quincy, Illinois. Telephone Conversation with author. 13 April 2000.

Redmon, Larry A. and Robert L. Woods. "Bermuda Grass for Grazing or Hay." Oklahoma Cooperative Extension Service Extension Facts F-2587. Oklahoma State University, 1995.

Sunrise Feeds Sales Staff, Cheyenne, Oklahoma. Telephone conversation with author, 13 April 2000.

Stoecker, Arthur, Doug W. Hamilton, Joe Zulovich, and John Haney. Swine Waste Management Program. Excel©/ Visual Basic Model. 1997.

United States Department of Agriculture, National Agricultural Statistics Service. *1997 United States Census of Agriculture.* Washington, D.C., 1999.

United States Department of Agriculture, National Agricultural Statistics Service. *Agricultural Prices 1998 Summary.*

United States Department of Agriculture, National Agricultural Statistics Service. *Historical Data.* <http://www.usda.gov/nass/pubs/histdata.htm#sb> 10 July 2002.

United States Department of Agriculture, National Agricultural Statistics Service. *Published Estimates Database.* <http://www.nass.usda.gov:81/ipedb/> 6 July 2002.

Table 1: Sizes and Crop Acreages for Modeled Operations

Oklahoma	Total Farm Size	1500 acres
	Total Cropland Acreage	640 acres
	Component Crops' Acreages	
	Wheat	320 acres
	Grain Sorghum	160 acres
	Corn	160 acres
North Carolina	Total Farm Size	200 acres
	Total Cropland Acreage	120 acres
	Component Crops' Acreages	
	Bermudagrass	120 acres
Iowa	Total Farm Size	380 acres
	Total Cropland Acreage	320 acres
	Component Crops' Acreages	
	Corn	160 acres
	Soybeans	160 acres

Table 2: Selection and Adjustment of Operational Characteristics

Operational Characteristic	**Means of Selection / Adjustment**
Farm Acreage	66^{th} percentile farm acreage for modeled county according to USDA census of Agriculture
Crop Mixture	Consultation with CSREES staff in each modeled state
Current/Adapted Waste Management System and Land Application System	Consultation with CSREES staff in each modeled state
Feed Ingredient Costs	Specific vendor bids in modeled region when available; nearest market costs adjusted by “indexing” USDA Agricultural Prices for Swine Ration when bids not available
Labor Costs	Labor costs “indexed” using UADA Agricultural Statistics
Utilities Costs	Utility costs “indexed” from USDA Census of Agriculture Data

Table 3: Comparison of Costs for Farrow to Feeder Operations

	Oklahoma		North Carolina		Iowa	
	Baseline	Proposed Regulations	Baseline	Proposed Regulations	Baseline	Proposed Regulations
Production Costs						
Waste Management Costs, $/head sold	$1.24	$1.61	$1.49	$1.75	$1.71	1.78
Breakeven Cost, $/head sold	$36.51	$36.89	$38.22	$38.48	$36.02	$36.09
Waste Management System Characteristics / Costs						
Waste Management System	Anaerobic Lagoon	Above-ground Tank	Anaerobic Lagoon	Above-ground Tank	Above-ground Tank	Above-ground Tank
Storage Volume (ft^3)	1,343,559 ft^3	259,984 ft^3	1,562,149 ft^3	302,242 ft^3	269,750 ft^3	269,750ft^3
Initial Investment Cost	$137,365	$258,376	$177,635	$253,704	$278,967	$274,533
Annual Cost of Operation	$32,349	$42,107	$38,849	$45,622	$44,579	$46,340
Lagoon Closure Costs	-	$188,098	-	$208,226	-	-
Land Application System						
Application System Type	Center Pivot	Drag-hose Injector	Traveling Gun	Drag-hose Injector	Haul-tanker Wagon	Haul-tanker Wagon
Volume of Waste Applied (Volume of Waste Remaining)	33.9 ac-in	23.3 ac-in (24.4 ac-in)	67.0 ac-in	11.6 ac-in (51.7 ac-in)	55.3 ac-in	19.1 ac-in (36.2 ac-in)
Additional Land Area Required (ac)	-	371 ac	-	494 ac	-	554 ac

Table 4: Comparison of Costs for Farrow to Finish Operations

	Oklahoma		North Carolina		Iowa	
	Baseline	Proposed Regulations	Baseline	Proposed Regulations	Baseline	Proposed Regulations
Production Costs						
Waste Management Costs, $/head sold	$1.22	$1.84	$1.33	$1.98	$1.90	$1.96
Breakeven Cost, $/head sold	$31.59	$32.21	$33.37	$34.03	30.71	$30.76
Waste Management System Characteristics / Costs						
Waste Management System	Anaerobic Lagoon	Above-ground Tank	Anaerobic Lagoon	Above-ground Tank	Above-ground Tank	Above-ground Tank
Storage Volume (ft^3)	4,079,592 ft^3	753,309 ft^3	4,529,734 ft^3	875,752 ft^3	665,591 ft^3	781,606 ft^3
Initial Investment Cost	$299,860	$588,447	$357,372	$604,795	$645,789	$632,034
Annual Cost of Operation	$72,589	$109,826	$79,427	$118,143	$101,230	$116,954
Lagoon Closure Costs	-	$571,143	-	$651,496	-	-
Land Application System						
Application System Type	Center Pivot	Drag-hose Injector	Traveling Gun	Drag-hose Injector	Haul-tanker Wagon	Haul-tanker Wagon
Volume of Waste Applied (Volume of Waste Remaining)	104.6 ac-in	22.5 ac-in (121.4 ac-in)	178.9 ac-in	11.1 ac-in (178.1 ac-in)	78.8 ac-in (87.0 ac-in)	18.3 ac-in (147.6 ac-in)
Additional Land Area Required (ac)	-	1,916 ac	-	1,888 ac	297 ac	2,357 ac

Table 5: Comparison of Costs for Finisher Operations

	Oklahoma		North Carolina		Iowa	
	Baseline	Proposed Regulations	Baseline	Proposed Regulations	Baseline	Proposed Regulations
Production Costs						
Waste Management Costs, $/head sold	$1.07	$1.44	$1.30	$1.58	$1.44	$1.60
Breakeven Cost, $/head sold	$35.48	$35.84	$36.44	$36.72	$34.55	$34.55
Waste Management System Characteristics / Costs						
Waste Management System	Anaerobic Lagoon	Above-ground Tank	Anaerobic Lagoon	Above-ground Tank	Above-ground Tank	Above-ground Tank
Storage Volume (ft^3)	1,188,246 ft^3	206,992 ft^3	1,388,478 ft^3	240,637 ft^3	185,913 ft^3	214,767 ft^3
Initial Investment Cost	$121,475	$226,379	$162,424	$216,919	$329,784	$238,693
Annual Cost of Operation	$26,387	$35,401	$32,064	$38,880	$35,582	$39,267
Lagoon Closure Costs	-	$166,354	-	$185,076	-	-
Land Application System						
Application System Type	Center Pivot	Drag-hose Injector	Traveling Gun	Drag-hose Injector	Haul-tanker Wagon	Haul-tanker Wagon
Volume of Waste Applied (Volume of Waste Remaining)	29.7 ac-in	22.1 ac-in (18.3 ac-in)	58.8 ac-in	7.9 ac-in (44.9 ac-in)	46.4 ac-in	17.9 ac-in (28.5 ac-in)
Additional Land Area Required (ac)	-	294 ac	-	604 ac	-	465 ac