A Review of the Proposal to Construct
A 3700 Sow Farrow to Finish Hog Operation
In Gray County, Texas

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Executive Summary

1. Total annual water consumption by the proposed CAFO would range be about 254 million gallons per year. These figures do not account for any on-site water usage other than drinking and flushing water. 254 million gallons of water usage is equivalent to the amount of water needed to fully support a town of about 4800 people and the all the industry and services contained within that town. Trading this resource for a single hog CAFO that, at best, would create about 15 on-site jobs is questionable from an economic development perspective.

2. The proposed CAFO would need about 3200 spreadable acres for the nitrogen generated by the operation and about 10,600 acres for the phosphorus. If phytase is used to reduce phosphorus excretion by 30%, 7400 acres would still be required to spread waste based on phosphorus.

3. A study of 1,106 rural communities by Gómez and Zhang of Illinois State University found that large hog farms tend to hinder rural economic growth at the local level.. Economic growth was 55% higher in areas with conventional hog farms as opposed to those with larger hog operations in spite of the fact that economic growth rates had been almost identical in all the studied communities before the advent of larger hog operations in the1990s. Data in the study also showed that communities with heavy hog concentration suffered larger population losses than those with conventional hog operations.

4. Since the motivation of a hog CAFO such as the one proposed for Gray County is to create profit, not to control pollution or engage in any of the other social benefits the region may desire, the CAFO can only be trusted to act in its own self interest. CAFOs use laws based on loose, conventional agricultural standards to avoid pollution controls that would more fully assign the costs of waste to the CAFOs.

5. Cost shifting by CAFOs occurs when the costs of health problems, traffic, social problems and pollution (odors, chemical and particulate air pollution; chemical, pathogen, and particulate water pollution) are transferred to the residents of a region and are neither paid by the CAFO responsible for the costs nor included in the price of the products they market.

7. CAFOs are structured so that they cannot aid regional economic development for the following reasons:

   <u>(a) Constraints on Regional Economic Development Due To Employment</u>

   If the same increase in hog production levels proposed for Pike County were achieved simply by expanding the herd size on conventional hog farms, three times as much employment would be created in the region.

   <u>(b) Constraints on Regional Economic Development Due To Taxes</u>

   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.

(c) 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. Historically, this factor has severely limited the economic impact of CAFOs on the regions in which they are situated.

Confined animal production can occasionally benefit local grain sellers, but only when it consumes all the grain produced in the region. If the region 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.[1] When grain is priced at the export level the only beneficiary of purchasing locally is the hog CAFO which saves on transportation costs.

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

For reasons inherent in the structure of CAFOs, 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 in the region.

[1] Hayes, Dermot, Iowa's Pork Industry--Dollars and Scents, Iowa State University, January, 1998.

Introduction

The economic model that became capitalism is based on efficiencies from standardization, specialization and concentration of productive resources. As capitalism developed and this model was applied to production activities, social and environmental problems such as child labor, unhealthy working conditions, unfair labor practices, and polluting activities often occurred. Over time, these issues were dealt with in the industrial sector through a framework of laws and regulations.

Recently, agriculture has moved toward an industrial model of production--Concentrated Animal Feeding Operations (CAFOs)--that exceeds the capacity of the land on which it is located to naturally process animal waste. In a fundamental sense, the ability of the land to naturally process animal waste defines the limits of sustainable agriculture. Agriculture can only be environmentally sustainable if it produces no more waste than the land available for waste application can absorb. Waste produced in excess of this amount must, at some point, be transferred off the land in the form of air- or water-borne pollution and when this occurs, the costs of this waste are shifted away from the land where the waste is generated.

Unfortunately, agriculture's shift to industrial CAFOs outpaced laws and regulations governing agricultural activities--laws and regulations that were meant for a non-industrial sector. This occurred partly because agriculture is viewed by society in general through a lens colored by the assumption that the enterprise of agriculture is a "closed system" where the density of animals is compatible with the land's ability to recycle animal waste.

One central rationale of laws to regulate industrial waste was the recognition that the assumption of a closed system did not apply to industries. Industrial waste often polluted the environment of those who lived around (or many miles from) the industry and laws were necessary to prevent the harm to society that might come from contact with this pollution. The laws governing industrial waste forced industry and the consumers of its products to "internalize" (pay for) the costs of dealing with this pollution.

The assumption of a closed system is usually no more applicable to CAFOs than it is to any other industrial operation, but CAFOs, masquerading as agricultural enterprises, have used the absence of laws governing agricultural pollution to avoid paying the costs of the waste generated by their operations. The reason CAFOs must shift the costs of their waste to someone else is that they are faced with significant diminishing returns in their operations. This has become the central issue in the debate about the two contracts under which CAFOs operate--the explicit contract that governs their relationships within the financial organization in which they exist, and the implicit contract between the CAFO and the region or community in which it is located.

I. THE INDUSTRIAL ORGANIZATION AND CONTRACT ISSUES INVOLVED IN OPERATING LARGE, CORPORATE HOG FARMS AND THE IMPLICATIONS OF THESE ISSUES FOR THE COMMUNITY.

Price is the mechanism by which any market conveys the basic information about supply and demand for a good. But markets in which CAFOs are employed have become very different from the old commodity-based models of agricultural production and the effects of these markets on the life and economies of local communities have changed significantly.

Initially, the issue of CAFOs seems simply to be one of price and efficiency. However, to a large extent it is really an issue of information. As Jones has noted, in agriculture

> [t]he critical emphasis is changing from resource allocation based on price to allocation based on strategic advantage...Until greater transparency of information in economic signals between industry levels occurs, there is a strong incentive for producers to develop formal partnerships through cooperatives, joint ventures, or vertical arrangements.[2]

These partnerships usually create two contracts of interest when a CAFO enters a region such as Gray County:

1. the contract within the CAFO's organization (National Pig Development, a wholly-owned subsidiary of Smithfield) where information is equally shared and where the motives of all players are a consistent and singular search for profit, and
2. a second contract between the Gray County region and the CAFO. This second contract is based on what economist's call *asymmetrical information*.

The term *asymmetrical information* refers to a situation where one of two individuals in an agreement or contract possesses more information than the other individual about the nature of the bargain. If one individual possesses critical additional information about the contract, this individual can use his proprietary information to gain an advantage in the bargain. Remember that capitalism is based on the concept of full and free information about all aspects of the market--something that was easy to achieve under the traditional agricultural model where no single player was big enough to affect the market or, by implication, to operate in such a manner that it could hide information on which the market price was based and thus, shift its costs.

Asymmetrical information affects the relationship between the CAFO and the county in the following manner. When a CAFO enters a rural region like Pike County, it strikes a verbal bargain with the communities in that region. This implicit contract is usually formed around stated, but not legally enforceable, promises of jobs and economic impact on the region.

The CAFO promises to provide these things in return for land, water, access, power and the other factors that are required for the CAFO to operate. This implicit contract also establishes a certain physical relationship with the region that manifests itself in the presence (or lack) of pollution, traffic, resource consumption, etc., that arise from the operation of the CAFO.

> For example, the CAFO will have to use about 250 million gallons of water each year from the Ogallala aquifer. This aquifer is already overused and is in danger in being

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[2] Jones, Elund, "The Role of Information in US Grain and Oilseed Markets," Review of Agricultural Economics, vol. 21, no. 1, Spring/Summer, 1999, pp. 244-247.

depleted in the next twenty to thirty years. The risk of what happens to the local community and the region if this occurs is shifted entirely to the residents of the region.

The CAFO organization is typically well informed about the legal contract with its organization and the implied contract with the region because it signed the legal contract and it extended the offers on which the regional contract is based. But the citizens of the region are privy to very little information about the CAFO's explicit contract with its organization. As a result, there is an incentive on the part of the CAFO to shift costs between the contracts based on each party's knowledge about those costs. The parties with the least information about costs (i.e., the county residents) are most likely to have those costs shifted in their direction.

Local, county, state, and national laws and policies on the environment and on zoning are important determinants of the location of CAFO facilities.[3] Further, these laws and policies affect the ability of CAFOs to control information about their operations and they are major determinants of the role the CAFO will play in the physical, social and economic environment of a region. Thus, the physical relationship between the CAFO and the region is essentially predetermined by the rules and policies that are already in place in the region--and this set of rules and policies is often based on the pivotal assumptions that:

1. all agricultural operations are similar to the conventional, closed systems that previously dominated agriculture.
2. animal waste, as a natural product, while annoying, is essentially harmless, and not as toxic as human waste.
3. most animal-raising operations can be treated as if the waste that results is from ruminate animals.

The question here is not whether the CAFO can make an implied contract with Gray County. Instead, the issue is that in addition to this contract being physically defined around incorrect assumptions, it will also be based on asymmetrical information that heavily favors the owners of the CAFO. Such a contract is likely to work in only one direction--it is likely to increase the profits of the CAFO by shifting the operating costs of the CAFO either to the region in which it is situated or, through some mechanism of pollution migration, to another region further removed from the CAFO. The certainty of this outcome follows directly from existence of asymmetrical information about the operation of the CAFO and from the motivation of the owners of the CAFO.

In theory, the permitting process used to evaluate CAFO applications should insure that the citizens of a region are fully informed about all aspects of the CAFO's proposed operation. If this was indeed the case, there would be no asymmetrical information. However, the nature of the permitting process--which is also usually based on incorrect assumptions that all agricultural projects are conventional in nature--allows the CAFO operator to acquire an operating permit while withholding significant amounts of information from the residents of the region. This occurs in the following ways:

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[3] Hennessy, David A. and Lawrence, John D., "Contractual Relations, Control, and Quality in the Hog Sector," <u>Review of Agricultural Economics</u>, vol. 21, no. 1, Spring/Summer, 1999, p. 53.

1. The CAFO's requirements for sterile operating facilities limit public inspection of and knowledge about the CAFO and even limit the overall organizational knowledge of many CAFO employees.
2. The usual position of the CAFO as a contract operation for a larger, out-of-area corporate interest (Smithfield) may limit even the CAFO operator's knowledge of the source of inputs (feeds, antibiotics, etc.), the rationale behind the amounts and types of inputs selected, and the actual value of the product (the pork) to the owner.
3. Out-of-area ownership severely limits the ability of regional residents to determine the motivation, trustworthiness, and credibility of those who own and operate the CAFO.
4. The short life span of CAFOs (normally, eleven to twelve years due to the increasing incidence of hog disease in older facilities) and the normal practice of building CAFOs as turn-key operations limits the ability of regions to establish any reliable record of CAFO performance before committing to a fully-constructed operation.
5. And finally, the CAFO permit approval process is often so rushed and so subject to information controlled by the CAFO that residents of the region have insufficient time to learn enough about the proposal to ask intelligent questions or to do relevant research on the proposal.

A combination of these factors creates an agreement (contract) between a CAFO and a region that is based on no-enforceable promises of jobs and economic development, but for which the actual information needed to validly assess the impact of the CAFO on the physical, social and economic environment is withheld from the public and is available only to the owners/operators of the CAFO. The result is that the county or other permitting agency has inadvertently created what economists call a moral hazard, a process that occurs when one party is better informed than the other about the characteristics of the transaction. By definition, a moral hazard leads to lower efficiency and to higher costs to the party that is least informed (in this case, a higher cost to the residents of Gray County if it hosts the CAFO.)

Having created a moral hazard, the region is now faced with a second economic condition called adverse selection. This provides an incentive for additional producers who also want to shift costs to the residents of the region to migrate to the area. Thus, additional CAFOs are likely to be attracted to the region. As Milgrom and Roberts note, adverse selection is "a kind of precontractual opportunism that arises when one party to a bargain has private information about something that affects the other's net benefit from the contract and when those whose private information implies that the contract will be especially disadvantageous for the other party agree to a contract."[4]

Casson has laid out the general outlines of the relationship that develops between the region and the CAFO as a result of these factors by noting that:

> the crucial question... is whether the other party to the transaction can be trusted. There are two fundamental approaches to engineering or creating trust. The one most

[4] Milgrom, P. and Roberts, J., Economics, Organization, and Management, Prentice Hall, Englewood Cliffs, NJ, 1992.

commonly used in much of the Western world is to monitor performance through the institutional and legal system and penalize those parties that do not fulfill their negotiated commitments. The alternative approach to engineering trust is to manipulate the incentive structure so that individuals fulfill their commitments based on rewards they receive rather than penalties they incur.[5]

For CAFOs, the issue of trust is directly tied to out-of-area ownership and the asymmetrical information in the agreement between the CAFO and the community. Since the motivation of a CAFO is to create profit, not to control pollution or engage in any of the other social benefits the region may desire, the CAFO can only be trusted to act in its own self interest. The interests of the region could initially be protected by disclosure of full information concerning the operations of the CAFO during permitting. However, due to the factors already discussed, the CAFO usually controls the information in this part of the process. The only recourse for the region is monitoring by knowledgeable regulators.

Unfortunately, monitoring measures compliance with laws that are often crippled by the same underlying assumptions about the nature of agriculture listed earlier in this section. CAFOs are able to use laws based on loose, conventional agricultural standards to avoid pollution controls that would more fully assign the costs of waste to the CAFOs. In addition, most of the factors that make it difficult to get information on proposed CAFO operations during the permitting process also complicate attempts to monitor CAFO operation. This leads to a condition called low separability. Separability is "...the feasibility to see who has done the work. With low separability, the principal [in this case, the region] will face either high control costs or intense cheating."[6]

So far, the history of CAFO operations shows that cheating is likely. And it is made even more likely by the decision on the part of many regulating agencies to rely on citizen complaints instead of more costly professional monitoring. If monitoring fails or is not effectively implemented, the only other option for controlling the behavior of the CAFO is through economic incentives. But, as previously noted, a powerful economic incentive structure is already in place and this incentive structure has been formalized in the explicit contract between the CAFO, its own organization, and its investors. This contract directs the CAFO to operate in such a way as to maximize profit, and if it can do this by shifting the costs of its waste to its neighbors in the region, that is how it will operate.

II. ECONOMIC EFFICIENCY AND THE NEED TO SHIFT THE COSTS OF CONCENTRATED ANIMAL FEEDING OPERATIONS TO THE LOCAL REGION

The economic issue of efficiency in production is central to the rationale for Concentrated Animal Feeding Operations. In this argument, the economic issue usually discussed is the concept of increasing returns to scale where the efficiencies are realized when

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[5] Casson, M., The Economics of Business Culture: Game theory, Transaction Costs and Economic Performance, Clarendon Press, Oxford, England, 1991.

[6] Sauvee, Loic, "Toward an Institutional Analysis of Vertical Coordination in Agribusiness," in The Industrialization of Agriculture, Jeffrey S. Royer and Richard T. Rogers, eds., Ashgate Press, Brookfield, VT, 1998, p. 55, 56.

more capital is brought to a production process. The resulting capital intensive process has a much higher reliance on machines and technology and is less reliant on labor. In the CAFO process, raw materials (feed, water, etc.) are submitted to hogs in confinement buildings and the output is pork.

In so far as hogs and their confinement facilities can be treated as machines, the CAFO philosophy is that they can be “improved” through the addition of capital to the production process. This “improvement” comes through standardization of hog breeds and sizes, control of growth rates and animal disease, and increased specialization of workers, managers, and animal raising facilities.

If this was all there was to the CAFO process, one would expect efficiency of operations to continue to increase as more capital in the form of hogs and buildings was added to the process. In other words, the maximum efficient size of hog CAFOs would be extremely large. Further, this concentration would bring other benefits. For example, a former Agriculture Commissioner in Minnesota has stated that

> As farms and feedlot operations get larger, there will be opportunities for important land and resource restoration to occur. Greater production of crops on fewer acres will make land available for important resource restoration activities. The prairies of the state have been mostly eliminated, and some of our most important biodiversity issues must be approached by restoring grassland habitats.... The larger farming operations will also provide greater opportunities for better management of wastes and capital intensive management methods for improved air and water quality.

The Commissioner's point is valid only if the efficiency of farm and feedlot operations continually increases as they get larger and larger. In this sense, efficiency means that average costs continue to drop. However, this is not the case. Efficiency quickly peaks as animal concentration rises because the cost of waste disposal for a CAFO increases sharply after one surpasses the ability of the land to absorb the waste. The fact that CAFOs try to avoid this cost by shifting the cost of their waste to the surrounding region makes no difference--the confined operation is still less efficient in an economic sense.

The Commissioner's statement also contains an unstated assumption--that the waste generated by concentrated operations stays on the site and that the land is capable of absorbing an unlimited amount of waste material. Carried to its (il)logical conclusion, the Commissioner's statement would lead one to concentrate all hogs on a single site.

There is a large body of law that already regulates problems of industrial concentration that arise from a similar condition to the one the Commissioner proposes: a point source of pollution from some concentrated industrial activity damages the health of the surrounding environment. Theoretically, a concentration of industry in various locations should, in the Commissioner's words, "[make] land available for important resource restoration activities" (because it is not covered by factories.) Instead, the waste flows from those concentrated activities ruined the surrounding environment and, in the case of acid rain, the environment thousands of miles away.

A CAFO only concentrates animals in less space, it does nothing to reduce the amount of land needed to raise feed for the animals and it does nothing to reduce the amount of land that ultimately is needed to recycle the animal waste. For this reason, a switch back to conventional farming simply places the animals on the land that is also used to grow their feed and uses the animal manure responsibly to fertilize that land so that feed can continue to be grown in a more-or-less closed system. In addition, spreading the animals out in this manner reduces the need for antibiotics.

The Efficient Size of CAFO Operations

Based on studies at the University of Missouri, between 1988 and 1991 only hog producers marketing less than 1,000 head annually lost market share. Between 1991 and 1994, all producers below 3,000 head marketed annually lost market share.[7] And by 2000, a team of Purdue University economists found that pork industry concentration had increased to the point where the top four pork processing firms controlled 56 per cent of the business.[8] However, if all the economic costs of CAFO operation are considered, two economic concepts--diseconomies of scale and diminishing marginal returns--both mandate that the efficient size of most animal feeding operations should be relatively small. To understand why smaller and medium sized hog operations have lost market share to the CAFO giants it is necessary to investigate how the expected effect of these two economic concepts has been altered by the actions of the CAFO industry.

The first economic concept--diseconomy of scale—usually comes into play when problems associated with some element of a production process increase much faster than the size of the process itself increases. With hogs such a situation occurs with attempts to control disease and the stress factors that occur during confinement, movement and transportation. The possibility of disease among hogs is so great that a heavy use of antibiotics, limitations with respect to shed populations, the requirement to maintain a sterile site, and time limits on how long hog operations can stay in one spot all act to create diseconomies of scale. In fact, large hog CAFOs are usually limited to ten to twelve years at a site before health factors become so overwhelming that they can no longer be controlled with certainty and the hog operation must abandon the site.

A second, more powerful economic concept called diminishing returns also ought to act to limit the size of efficient CAFO operations. Under this concept, when units of a variable resource (such as hogs) are added to a fixed resource (such as land) one reaches a point where the marginal product (the revenue gained from the last hog added to the operation less the cost of the last hog added to the operation) of the variable resource begins to decline. Because of the costs of handling animal waste responsibly, the point at which this decline occurs is closely

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[7] Grimes, Glen, and Plain, Ron, "The US Swine Industry - Where to from Here?," Proceedings of Swine Strategies '95, Summer, 1995.

[8] Paarlberg, Philip, "Structural Change and Market Performance in Agriculture: Critical Issues and Concerns about Concentration in the Pork Industry, Testimony before the Senate Committee on Agriculture, Nutrition, and Forestry, Washington, DC, February 1, 2000, in Anthan, George, "Hog-industry concentration assessed," Des Moines Register, Washington Bureau, February 27, 2000.

related to the ability of the land on which the CAFO is located, and the land over which the CAFO will apply its waste effluent, to absorb and recycle the manure. If diminishing returns to a CAFO did not exist, all the hogs in the world could be raised on a single, small plot of land. This is clearly the philosophy of some in the hog industry who recognize no limits to hog farm growth. For example, Freese has stated that "[c]ompletely comparable costs are not publicly available to distinguish between a declining or flat average cost curve in the long run, but what is clear is that diseconomies of size are not limiting the growth of firms with 95,000 sows."[9] Such a statement, which completely disregards diminishing returns from hog waste and confinement, is nonsense.

To overcome these costs, CAFOs have been designed to take full, economic advantage of the assumptions about agriculture listed in the previous section—assumptions that not only form the basis for CAFO permitting and regulating but also establish the tax and subsidy policies that create the economic environment in which CAFOs operate. These assumptions allow important costs of CAFO operations to be either omitted or understated in the profit and loss calculations of the CAFO. They also allow the CAFO to take advantage of important tax and investment opportunities that, in effect, subsidize its operation. These factors artificially inflate the amount of profit available from CAFO operations and generate short term gains for developers and investors. While this would be significant in itself, artificially inflated profits also act to draw more investment into CAFO operations, contribute to the proliferation of CAFOs, and provide an economic incentive for an organizational model that gives rise to the four common attributes of every CAFO:

(1) The use of capital intensive production methods. CAFOs use less labor and more machinery to achieve production output.

(2) Employment of a production methodology that maximizes tax benefits and subsidy availability to the corporation.

(3) The use of vertically integrated operations where separate divisions of the same company produce the different stages of a product and market their output to one another.

(4) The use of cost shifting to reduce the costs of production. Cost shifting occurs when the costs of health problems, traffic, social problems and pollution (odors, chemical and particulate air pollution; chemical, pathogen, and particulate water pollution) are transferred to the residents of a region and are neither paid by the company responsible for the costs nor included in the price of the products they market.

In sum, arguments about the efficient size of CAFO operations assume that the purpose of the organization and hence, the output of its operations, are both known and clearly specified; i.e., the purpose of a CAFO may be assumed to be pork production within certain product specifications. Further, these arguments also assume that the CAFO and the more conventional farming operation to which the CAFO is compared both have the same fundamental production objectives. However, as the above-listed attributes demonstrate, it is not clear that pork production is the primary objective of the CAFO proposed for Gray County. Indeed, because a typical CAFO is designed to

[9] Freese, B., "Pork Powerhouses," Successful Farming, October, 1995, pp. 20-22.

1. maximize tax benefits in both industrial and agricultural categories, and
2. maximize subsidies for both industrial and agricultural operations, and
3. shift as many costs as possible to the local region while
4. producing an agricultural commodity (raising animals),

it is not clear what weight if any, one should give to efficient sizes for pork production when discussing a CAFO operation. Any comparison of efficiency is further complicated by the fact that the price of CAFO commodities is more likely to be set by the competitive needs of the organization as a whole (in other words, the competitive price of the final, processed products produced by the vertically integrated organization--i.e., Ramsey Pricing) than by the actual need to directly compete with other producers of pork or chicken. As a result of these factors, CAFOs are also particularly ill-suited to aid in regional economic development.

III. THE ECONOMIC EFFECT OF CAFO PRODUCTION ON REGIONAL ECONOMIES

Interference with Amenities and Property Values

Amenities are those characteristics that make a region pleasant or a desirable residence. Amenities differ from one region to another, but each amenity helps create a quality of life that draws people to an area and makes them want to stay there. Large CAFOs tend to diminish local amenities:

A. In 1990, Abeles-Allison and Connor found that large, concentrated animal-feeding operations decrease land values near production facilities..[1]

B. In 1999 Chapin and Boulind also found that the effects of large hog farms on the amenities of a region are far reaching. Besides the odor and gases, improperly managed manure wastes and pre-slaughterhouse carcasses threaten water quality. The close proximity of humans to these facilities raises concerns that infectious diseases may cross over from animals to humans. In addition, new evidence indicates that the use of antibiotics can contribute to the increase of antibiotic resistance in human pathogens. [2]

C. In a 2001 study of farming dependent areas , Tweeten and Flora found that if they create environmental problems newly developed or arrived CAFOs may undermine a community's opportunities to expand its economic base. They also found that the vertical coordination structure used by large CAFOs can cause a loss of resources from farms and rural communities because CAFO facilities tend to be so large and because ownership and control may reside in distant metropolitan centers. All else being equal, they found the productivity gains attributed to large CAFOs decrease aggregate employment and other economic activities in rural communities. [3]

D. In 2001, John Kilpatrick of Mundy Associates, the leading US appraisal and property stigma analysis firm, determined that "diminished marketability, loss of use and enjoyment, and loss of exclusivity can result in diminishment ranging from 50% to 90% of [the] otherwise unimpaired value" of property located in the vicinity of a CAFO.[4]

E. A 2000 study of 1,106 rural communities by Gómez and Zhang of Illinois State University who found that large hog farms tend to hinder rural economic growth at the local level.. All models in this study indicated an inverse relationship between hog production concentration and retail spending in local communities. Economic growth rates were 55% higher in areas with conventional hog farms as opposed to those with larger hog operations in spite of the fact that economic growth rates had been almost identical in all the studied communities before the advent of larger hog operations in the1990s. Data in the study also showed that communities with heavy hog concentration suffered larger population losses than those with conventional hog operations. According to the authors, the results of this study suggest that without public policy to protect rural communities, the most probable outcome is the continuing decline of rural communities in the future as the size agriculture and livestock production units continue to increase.[5]

F. A study by Palmiquist, Roka and Vulkina (1998) showed that large hog operations tend to depress the sales value of nearby homes and real estate.[6]

G. An eighteen month study of 75 rural land transactions near Premium Standard's hog operations in Putnam County, Missouri conducted by the departments of Agricultural Economics and Rural Sociology at the University of Missouri found an average $58 per acre loss of value within 3.2 kilometers (1.5 miles) of the facilities. This study primarily evaluated farmland without dwellings.

H. These findings were confirmed by a second study at the University of Missouri-Columbia by Hamed, Johnson, and Miller that found that proximity to a hog ILO does have an impact on property values. Based on the averages of collected data, loss of land values within 3 miles of a hog CAFO would be approximately $2.68 million (US) and the average loss of land value within the 3-mile area was approximately $112 (US) per acre.[7]

I. Actual property tax adjustments by county assessors in at least eight states confirm these lowered property taxes for neighbors of CAFOs. As Table 1 shows, local property tax assessments have been lowered in Alabama, Illinois, Iowa, Kentucky, Maryland, Michigan, Minnesota and Grundy County, Missouri. Grundy County has lowered some residents' taxes by up to 30% due to their close proximity to the corporate hog operations of Continental Grain.

Table 1--Property Tax Reductions In Areas Around CAFOs

Area	Amount of Reduction	Reduction In Value Of:
Grundy Co, MO	30%	
Mecosta Co, MI	35%	dwellings only
Changed to	20%	total property (land and structures)
Midland Co, MI	20%	
DeWitt Co, IL	30%	rescinded
McLean Co, IL	35%	
DeKalb Co, AL	base reassessment, variable rates	
Renville Co, MN	base reassessment, variable rates	dwellings only

Humbolt Co, IA	20-40%	dwellings only--now rescinded
Frederick Co, MD	10%	now reduced to 5%
Muhlenberg Co, KY	18%	dwellings only

Radius of reduction varied, up to 2 miles. All were for hogs except Muhlenberg, for chickens.
Source: Property Tax Reductions, scott.dye@sfsierra.sierraclub.org, March 13, 2000

The Potential Impact of CAFO Production On Regional Economies

The four economic characteristics that generally define a CAFO 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 they will not 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.[8] Ikerd calculated that a farrow-to-finish contact hog operation would employ about 4.25 people in to generating 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.[9]

Further, large scale animal production facilities are more likely to purchase their inputs from a great distance away, bypassing local providers in the process.[10] A number of studies have found that compared with small farms with an equivalent composite production value, a large farm tends to buy a smaller share of consumption and production inputs in nearby small towns. 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 expenditures locally while farms with gross incomes in excess of $900,000 spent less than 20% locally.[11]

This is important because local employment from a CAFO's operations depends on amount of purchases the CAFO makes in the region. Input-output analysis shows each farm job adds another job in local communities and another in the state outside the local communities. Similarly, each $1,000 of farm income adds an-other $1,000 to local communities and another $1,000 to the state outside the local communities.[12]

Confined animal production can occasionally benefit local feed sellers, but only when it consumes all the hay or grain produced in the county. If the county has to export one bushel of grain or one bale of hay, all the grain and hay in the county will have to be priced to compete in the export market.[13]

(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, road repairs, and environmental monitoring. 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.[14] 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. [15] 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. [16]

(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. [17]

Tweeten and Flora also find that consolidation affects the ability of small producers to respond to shifting demand by entering or leaving markets. Large CAFOs tend to have higher overhead costs (fixed costs for facilities and equipment) than operating costs (variable costs for labor and feed). This means that in hog CAFOs, large buildings must be kept full in order to minimize cost/unit and in the face of falling prices, large CAFOs will increase production because it lowers their overall cost to produce each pig.

Conversely, conventional operations have lower fixed costs and higher variable costs. These operations will reduce their production in a time of falling prices. Thus, in the past, the burden of adjusting hog supply to weak demand has fallen on small producers and it has driven most of them out of the market. [18] The demise of the majority of small producers has created a dilemma for large hog CAFOs because it signals an end to the period when overproduction by large producers can be absorbed by forcing small producers out of the market. To address this problem, large hog agribusiness appears to be creating another class of small farmers—contract operators--who can be cut out of the market when demand falls. Since the fate of these individuals is entirely in the hands of large agribusiness concerns, it will be easy to quickly create slack in the markets when hog prices fall by simply canceling contracts and removing hogs from the contract producers.

(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 also 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. For example, some of these costs may arise from:

A. The Potential Cost of Groundwater Contamination From Manure

All manure lagoons leak and this leakage can contaminate groundwater. Han found that after accounting for evaporation, seepage from lagoons averaged.05 inch. per day. The lagoons studied ranged in size from 1.24 to 6.2 acres with waste depths between 5 and 18.5 feet and all were built with compacted soil/bentonite liners. Calculated nitrogen export losses from seepage were 1826 to 2738 pounds/acre/year.[19]

Ruhl studied earthen basins with above-grade, earth-walled embankments and compacted clay liners. The hog basins held a manure-water mixture and monitoring systems were installed below the compacted clay liners both in the sides and the bottom of the basin. Seepage from the basin ranged from 400-2200 gallons per day except during one month and three month periods when 3800 to 6200 gallons per day. Seepage flow in areal units ranged from .025 to .43 inches/day. Except during the first three months when the basin was filling, seepage flow was greater through the sidewalls than through the bottom of the basin. Nitrate-N concentrations in the seepage exceeded the US Environmental Protection Agency drinking water standard of 10 mg/L in 17 of 22 samples.[20]

B. The costs of closing lagoons

In South Carolina, where the state has been forced to assume responsibility for closing hog lagoons, the cost has averaged $42,000 per surface acre of lagoon. These costs are paid by the taxpayers of state, not the companies that created the lagoons.[21]

C. Potential costs of health-related problems

(a) Potential Costs from Pathogens, Chemical and Antibiotics in Manure

A large number of diseases are present in animal manure. These diseases are not present in inorganic fertilizers. Table 2 shows that the potential presence of 25 different diseases in animal manure make this form of fertilizer very different from the inorganic chemicals that are used as crop fertilizer.

Table 2, Diseases and organisms spread by animal manure

Disease	**Responsible organism**	**Disease**	**Responsible organism**
Bacterial		Viral	
Salmonella	Salmonella sp	New Castle	Virus
Leptospirosis	Leptospiral pomona	Hog Cholera	Virus
Anthrax	Bacillus anthracis	Foot and Mouth	Virus

Tuberculosis	Mycobacterium tuberculosis	Psittacosis	Virus
	Mycobacterium avium		
Johnes disease	Mycobacterium	Fungal	
	paratuberculosis	Coccidioidomycosis	Coccidoides immitus
Brucellosis	Brucella abortus	Histoplasmosis	Histoplasma capsulatum
	Brucella melitensis	Ringworm	Various microsporum
	Brucella suis		and trichophyton
Listerosis	Listeria monocytogenes	Protozoal	
Tetanus	Clostridium tetani	Coccidiosis	Eimeria sp.
Tularemia	Pasturella tularensis	Balantidiasis	Balatidium coli.
Erysipelas	Erysipelothrix rhusiopathiae	Toxoplasmosis	Toxoplasma sp.
Colibacilosis	E.coli (some serotypes)		
Coliform mastitis	E.coli (some serotypes)	Parasitic	
Metritis		Ascariasis	Ascaris lumbricoides
		Sarcocystiasis	Sarcocystis sp.
Rickettsial			
Q fever	Coxiella burneti		

Source: Agricultural Waste Management Field Handbook, United States Department of Agriculture Soil Conservation Service, April, 1992, p. 3-13, 3-14.

The pathogens present in manure are not found in inorganic chemicals. These pathogens could be transported to ground water supplies through improperly sealed wells or other naturally occurring pathways. Many incidents of human disease attributable to contact with livestock waste have been reported. Stanley et al. (1998) isolated Campylobacter jejuni from groundwater in the Arnside area of Cambria. Some of the strains isolated were of the same biotype as the ones from a dairy farm situated within the hydrological catchment of the polluted spring indicating that the groundwater was a vehicle for bacterial transmission. In a longitudinal study of four dairy farms, it was suggested that E. coli O157:H7 was disseminated from a common source on these farms and that this strain could persist in the herd for up to 2 years (Shere et al., 1998).[22]

Large numbers of viruses are excreted in infected animal feces. In fact, enteroviruses have been found in all animal species that have been extensively studied. These animal viruses can gain entrance to streams, lakes and other bodies of water via land application of animal wastes or by direct contamination from pastures and feedlots. [23]

(b) Potential costs of odors

There is evidence that odors from concentrated animal facilities can produce real illnesses in affected populations adjacent to these facilities. A report by the State Health Director of North Carolina notes that exposure to environmental odors results in physiological stresses that may result in a variety of symptoms including headache, nausea, loss of appetite, and emotional disturbance. Odors may exacerbate stress-related illnesses. The symptoms may result from odor annoyance, stress associated with odor exposure, and conditioned responses to odors. The literature also reports that exposure to odors may exacerbate asthma symptoms.[24] The following excerpts of articles address human response to environmental odors:

N. P. Shukia (1991) "In the case of humans, the immediate physiological stresses produced by odors can cause loss of appetite and food rejection, low water consumption, poor respiration, nausea, and even vomiting, and mental perturbations. In extreme cases, offensive odors can lead to deterioration of personal and community well-being, interfere with human relations, deter population growth and lower its socio-economic status."[25]

Dennis Shusterman (1992) "Environmental odor pollution problems generate a significant fraction of the publicly-initiated complaints received by air pollution control districts. Such complaints can trigger a variety of enforcement activities under existing state and local statutes. However, because of the transient timing of exposures, odor sources often elude successful abatement. Furthermore, because of the predominantly subjective nature of associated health complaints, air pollution control authorities may predicate their enforcement activities upon a judgment of the public health impact of the odor source. Noxious environmental odors may trigger symptoms by a variety of physiologic mechanisms, including exacerbation of underlying medical conditions, innate odor aversions, aversive conditioning phenomena, stress-induced illness, and possible phenomenal reactions."[26]

Shim and Williams (1986) "Many patients complain that some odors worsen their asthma. Perfume and cologne are two of the most frequently mentioned offenders. A survey of 60 asthmatic patients revealed a history of respiratory symptoms in 57 on exposure to one or more common odors. Odors are an important cause of worsening of asthma. From a practical standpoint, sensitive asthmatic patients should be advised to eliminate odors from their environment as much as possible."[27]

Susan Knasko (1993) "The effects of intermittent bursts of pleasant, unpleasant, and no experimental odor on human task performance, mood, and perceived health were tested in this study. Odors did not influence any of these measures; however, subjects who had been exposed to the malodors reported retrospectively that they thought the odors had a negative effect on all of these factors."[28]

Pierre Caralini (1994) "With regard to general health complaints, it was found that when exposed to odorant concentrations, some people are annoyed and of these people, only some report general health complaints. Exposure in itself does not directly cause general health complaints. Annoyance is the intervening variable between exposure and general health complaints. A possible explanation for the relation between annoyance by malodor and general health complaints might be found in the personality and attitudes of the exposed individual. Finally, we found confirmation for the appraisal hypothesis, i.e., the extent to which individuals regard malodor as threatening is positively related to odor annoyance."[29]

Shusterman, et. al. (1991) "Retrospective symptom prevalence data, collected from over 2000 adult respondents living near three different hazardous waste sites, were analyzed with respect to both self-reported 'environmental worry' and frequency of perceiving environmental ("particularly petrochemical) odors. Significant positive relationships were observed between the prevalence of several symptoms (headache, nausea, eye, and throat irritation) and both frequency of odor perception and degree of worry. Headaches for example, showed a prevalence odds ratio of 5.0 comparing respondents who reported noticing no such odors and 10.8 comparing those who described themselves as 'very worried' versus 'not worried' about environmental conditions in their neighborhood."[30]

Summary—Economic Impacts

Costs such as those in (1) to (4) above can also directly affect both long and short run regional economic development. As Tweeten and Flora note, costs of odor-, waste-, and pest-control need to be charged to the producing units and not to their neighbors or to other "downstream" parties.[31] Unfortunately, the costs of hog CAFOs are currently charged to the residents of the region and the regional effect of this cost shifting is felt both in its impacts on current residents and on those residents and businesses that do not move to the region due to the presence of these costs. Put bluntly, every company and every potential resident have 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 neither companies nor potential residents would never consider locating in an area where a large hog CAFO is operating.

IV. FACTORS INHERENT IN LARGE CAFO PRODUCTION THAT WILL RESULT IN SUBSTANTIAL DIMINISHING RETURNS TO THE PROPOSED GRAY COUNTY HOG CAFO OPERATION

Based solely on the law of diminishing returns, one would expect that as larger amounts of animal waste are handled and as more animals are crowded into confined spaces in close proximity to one another, the potential for disease and the costs of waste handling both mandate that the maximum efficient size of a CAFO is relatively small. Thus, for a large CAFO to compete with other agricultural producers, these costs must be offset by benefits from other phases of the operation such as:

(1) using animal waste for methane generation (a part of the proposal for Pike County) or fertilizer application or
(2) offsetting the problems of proximity and the cost of antibiotics this requires through efficiencies that come from reduced labor requirements and/or standardization.

If these benefits cannot compensate for the increased costs of CAFO operation, the additional costs arising from diminishing returns must either be shifted away from the large CAFO producer so they are not reflected in the accounting cost of production or it is likely that the large CAFO producer will not be able to compete.

The true costs of waste application to cropland will exceed the benefits unless water is plentiful and cheap, heavy metal contaminated sludge can be cheaply and safely disposed of, huge areas of non-ground crop land are available to the CAFO for waste application, and the CAFO is so isolated that its odor and potential health problems cannot adversely affect its neighbors. The likelihood of any, let alone all of these conditions occurring in a region is very small.

Whether or not the costs of preventing disease through crowding are recouped through efficiencies that arise from reduced labor and standardization is irrelevant to this discussion because these costs and benefits are completely overwhelmed by the costs of handling the animal waste. As a result, the economic viability of a CAFO can be evaluated solely by comparing the costs and benefits of handling animal waste. For example, take the case of swine production in a typical CAFO where:

(1) each hog produces 1.9 tons of waste annually.
(2) each hog generates .064 pounds of nitrogen per day or 23 pounds per year.
(3) each hog generates .0213 pounds of phosphorus per day or 7.8 pounds per year.[10]

Responsibly Handling CAFO Waste

The primary goal of all waste treatment is to eliminate pathogens. A secondary goal is to reduce the biochemical oxygen demand (BOD--the carbon and nutrient substrate for microbial decomposition) so that the waters that receive waste runoff do not become anaerobic. Finally, some heavy metals must be removed before the waste is discharged. In a sewage treatment plant for human waste, aerobic decomposition kills human pathogens and reduces the BOD while the settling process removes heavy metals to sludge (which then must be safely disposed of).

[10] "Hog Waste," Get the Facts: Fact Sheets, Environmental Defense Fund, 1999.

Table 1 Pollution Strength of Livestock and Municipal Waste

Type of Waste	BOD5 mg/l	Ammonia, NH_4N mg/l
Undiluted Livestock Waste	40,000	10,000
Manure Lagoon Effluent	14,400	-
Runoff From a Concrete Lot	1,000	-
Runoff From a Dirt Lot	500	-
Raw Municipal Sewage	250	50
Treated Municipal Sewage	30	1.5

Source: Understanding the Pollution Potential of Livestock Waste, Illinois Environmental Protection Agency, 1991.

One reason the concept of diminishing returns should be a powerful deterrent to large CAFOs is that the cost of responsibly handling and treating animal waste is so high. Neither anaerobic decomposition in animal waste lagoons nor methane generation eliminates human pathogens and BOD, and they both leave heavy metals in the lagoon. As opposed to assumptions about its "natural and thus, harmless, nature," livestock manure creates pollution with a strength that far exceeds raw municipal sewage. As Table 1 shows, the BOD concentration in undiluted livestock waste is 160 times more powerful than raw municipal sewage and ammonia is 200 times more concentrated. Even after it has been flushed to lagoons, manure effluent is still 57 times more powerful than raw sewage.

Exposure of land-applied wastes to sunlight and microbial activity in the soil will generally finish the job of pathogen control, and the nutrients that affect BOD may be used by crop plants. In effect, application to farm land is a final step in the "treatment" of animal waste if the amount of land to which it is applied is sufficient to perform this function.[11]

Whatever method is chosen for land application, construction of lagoons to hold the effluent until it can be applied to the land is also required. It is also implied that the CAFO has enough land for responsible nutrient application, and that the number of animals at the CAFO has been determined based on the amount of spreadable acreage available--and not vise-versa. It also implies sufficient, leak-free lagoon capacity to see the CAFO through the months in which the waste is not applied. In sum, the requirement to spread the waste to kill pathogens creates a significant transition point in the ability of the CAFO to responsibly handle waste. Appendices 1 and 2 show that for hogs this point is relatively easy to calculate:

At an application rate for nitrogen of 200 1b/acre:

> The nitrogen generated by the initial proposal would need 3194 spreadable acres for application..

[11] Lasley, Paul; Duffy, Mike; Ikerd, John; Kliebenstein, Jim; Keeney, Dennis; and Lawrence, John, "Economic Development," Understanding the Impacts of large-scale Swine Production, Proceeding from an Interdisciplinary Scientific Workshop, Des Moines, Iowa, June 29-30, 1995, pp. 14-15.

At an application rate of 30 pounds of phosphorus per acre (about 69 pounds of P_2O_5):

319,462 pounds of phosphorus need 10,648 acres.. If phytase is used and if a full 30% reduction in excreted P occurs, the proposed CAFO would still need 7454 acres.

These phosphorus calculations are a long-term requirement to avoid phosphorus buildup in the soil. Further, even though they are not a state requirement in Texas, they are a maximum for responsible waste spreading to avoid migration of phosphorus into off-field surface and drinking waters and eutrification problems in local water ways.

Often, a CAFO finds that responsibly spreading the waste on the land turns out to be impractical. Recently, many CAFOs have decided to simply hold the waste in large lagoons until it evaporates. This creates three major problems: First, lagoons leak. Second, lagoon storage does nothing to destroy the pathogens in the waste. And third, the materials in the waste--nitrogen, phosphorus, heavy metals, and salts--are now concentrated in pits for which there are usually no remediation plans even though they would qualify as hazardous waste dumps based on the chemical makeup of the materials they contain.

Water Use At the Proposed Gray County Hog CAFO

According to the rather sketchy details of the Gray County hog CAFO proposal, water use at the proposed CAFO is so heavy that it will put a significant demand on the underlying aquifer. Appendix 3 shows the expected water use for a flush operation with the number of hogs proposed by the Gray County hog CAFO. The likely total water use by the proposed CAFO would be

Total Drinking and Flushing Water:
254,027,200 gallons of water per year or
696,000 gallons of water per day.

These figures do not account for other, non-animal water uses at the site and unless some of the fluching water is recycled, they assume a pumping rate from the Ogallala aquifer of about 500 gallons per minute year round.

The 254 million gallons of water usage associated with the proposal is equivalent to the amount of water needed to fully support a town of about 4800 people and the all the industry and services contained within that town. Trading this resource for a single hog CAFO that, using industry standards, would create about 15 on-site jobs is not an attractive bargain.

Appendix 1

Spreadable Acreage Requirements Based on Nitrogen

Total excreted N/head/day[12]

Gestating Sow: .0421 lb./head/day (169 days) (2 cycles) (3700 sows)
=52,650 lb./year.

Farrow Sow w/litter: .1318 lb./head/day(14 days)(2 cycles)(3700 sows)
= 13,654 lb./year.

Nursery Pig: .0162 lb./head/day (42 days) (3700 sows)(20)
= 50,350 lb./ year.

Finish Pig: .0588 lb./head/day (120 days) (3700 sows)(20)
= 522,144 lb./ year.

Total = 638,798 pounds of nitrogen per year.

Assume an average application rate of 200 lb/acre.

Note: A recent study of swine effluent application in Yuma County, CO, found that the agronomic rate for corn at 180 bu/acre was 185 lb N/acre.[13] Application rates for corn elsewhere in the US are considerably lower. For example, in Pennsylvania rate of 50 to 150 pounds per acre of corn are normal.[14]

Then at a rate of 200 1b/acre:

The nitrogen generated by the proposed operation would need 638,798/200 = 3194 acres.

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

[13] Al-Kaisi, Mahdi, and Waskom, Reagan, Summary Report: Swine Effluent Study 1995-1997, Department of Soil and Crop Sciences, Colorado State University, 1998, p.1.

[14] Lanyon, L.E. and D.B. Beegel, 1993, “A nutrient management approach for Pennsylvania: Plant nutrient stocks and flows,” Agronomy Facts 38-B, Department of Agronomy, The Pennsylvania State University, University Park, PA.

Appendix 2

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.[15] Studies in Colorado yielded a nitrogen/phosphorus ratio of 5:1 for corn in Yuma County, Colorado.[16] 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."[17]

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 excreted P/head/day:

Gestating Sow: .0211 lb./head/day (169 days) (2 cycles) (3700 sows)
=26,388 lb./ year.

Farrow Sow w/litter: .0659 lb./head/day(14 days)(2 cycles)(3700 sows)
= 6827 lb./year.

Nursery Pig: .0081 lb./head/day (42 days) (3700 sows)(20)
= 25,175 lb./year.

Finish Pig: .0294 lb./head/day (120 days) (3700 sows)(20)
= 261,072 lb./year.

Total = 319,462 pounds of phosphorus per year or 734,758 pounds of P_2O_5.

Some operations propose to use the enzyme phytase in their feed rations and claim this will decrease the amount of excreted phosphorus by roughly 30 %. Thus, with phytase added the amount of phosphorus excreted could be expected to be as little as 223,623 pounds (or about 514,330 pounds of P_2O_5).

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

Thus, phosphorus requirements are about 27-33 pounds per acre (note: these estimates are also confirmed in actual crop tests by Al-Kaisi and Waskom.)[18]

A University of Pennsylvania publication 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

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[15] Pennsylvania State University, The Agronomy Guide 1995-1996, College of Agricultural Sciences, The Pennsylvania State University, University Park. PA, 1994.

[16] Al-Kaisi et. al., Op. Cit., p.5.

[17] 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. 30.

[18] Al-Kaisi et. al., Op. Cit., p.5.

ppm, phosphorus application should be discontinued in most of these states.[19] Over application of phosphorus not only leads to the unfavorable buildups just noted it is the major contributor to eutrification of rivers and estuaries.

At an application rate of 30 pounds of phosphorus per acre (about 69 pounds of P_2O_5): 319,462 pounds of phosphorus need: 319,462/30 = 10,648 acres. If phytase is used and if a full 30% reduction in excreted P occurs, the proposed project would still need 7454 acres.

[19] Managing Phosphorus for Agriculture and the Environment, Penn State, College of Agricultural Sciences, Cooperative Extension, 1999, p. 4, 12.

Appendix 3
Water Use In The Proposed Hog CAFO

Normal 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. [20]

Normal Drinking Water Use:
Total drinking water consumption/head/year:(Source of figures: [21])
Gestating Sows: 5 gallons/head/day (169 days) (2 cycles) (3700 sows)
= 6,253,000 Gals/ year.
Farrow Sow w/litter: 7 gallons/head/day(14 days)(2 cycles)(3700 sows)
= 725,200 Gals/year.
Nursery Pig: 3 gallons/head/day (42 days) (3700 sows)(20)
= 9,324,000 Gals/year.
Finish Pig: 4 gallons/head/day (120 days) (3700 sows)(20)
= 35,520,000 Gals /year.
Total = 51,822,200 gallons of drinking water per year or
141,798 gallons of drinking water per day.

Some hog operations makes the claim that new and improved pig feeding and drinking devices cut water use by up to 50% by preventing spillage and waste. While statistics that use the words "up to" allow for any usage decrease from zero to 49% and hence, are essentially meaningless, assume that a 50% reduction was achieved. This equates to a drinking water use rate of about 71,000 gallons per day. These figures are the most optimistic estimate of the lowest possible drinking water use. These optimistic figures does not include any flushing water--and flushing is the major use of water in a confined hog operation.

Normal Flushing Water Use:
Total waste flushing water /head/year:(Source of flushing water figures: [22])
Gestating Sow: 15 gallons/head/day (169 days) (2 cycles) (3700 sows)
= 18,759,000 Gals/year.
Farrow Sow w/litter: 35 gallons/head/day(14 days)(2 cycles)(3700 sows)
= 3,626,000 Gals/year.
Nursery Pig: 15 gallons/head/day (42 days) (3700 sows)(20)
= 46,620,000 Gals/ year.
Finish Pig: 15 gallons/head/day (120 days) (3700 sows)(20)

[20] 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.
[21] Donham et. al., Op. Cit., p. 14.
[22] Ibid.

= 133,200,000 Gals/year.
Total = 202,205,000 gallons of flushing water per year or
552,000 gallons of flushing water per day.

Total Drinking and Flushing Water:
254,027,200 gallons of water per year or
696,000 gallons of water per day.

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[10] 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.
[11] Chism, J. and R. Levins. 1994. "Farms spending and local selling: How much do they match up?" Minn Agric Econ 676:1–4 and Henderson, D., L. Tweeten, and D. Schreiner. 1989. "Community ties to the farm." Rural Dev Perspect 5(3):31–35.
[12] Sporleder, T. 1997. Ohio Food Income enhancement program. Agricultural, Environmental, and Development Economics Department, Ohio State University, Columbus, p. 9.
[13] Hayes, Dermot, Iowa's Pork Industry--Dollars and Scents, Iowa State University, January, 1998.
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[15] Park et al., op. cit.
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