9-1998

The Pork Industry: Environmental Regulations and Competitiveness

Darin Wohlgemuth
_Iowa State University_

Gail Thuner
_Iowa State University_

John Beghin
_Iowa State University_

Mark Metcalfe
_Iowa State University_

John Miranowski
_Iowa State University_

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The Pork Industry: Environmental Regulations and Competitiveness

Abstract
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Disciplines
Agribusiness | Business Administration, Management, and Operations | Environmental Policy | Environmental Studies
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Environmental Regulations and Competitiveness

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with
John Beghin, Mark Metcalfe and John Miranowski

September 1998
Economic Report #47
The Pork Industry: 
Environmental Regulations and Competitiveness

by

Darin Wohlgemuth
Temporary Assistant Professor

and

Gail Thuner
Research Assistant

with

John Beghin
Associate Professor

Mark Metcalfe
Research Assistant
(North Carolina State University)

and

John Miranowski
Professor and Chair

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Department of Economics
Iowa State University
Abstract

Because of pork production's increasing importance to the U.S. and world economies, questions concerning the relationship among environmental regulations, manure management practices, and production costs have arisen. The goal of this report is to discern whether competitive advantages exist in particular U.S. regions or countries.

The current levels of the rapidly changing environmental regulations in five key hog producing states are discussed in addition to possible geophysical and legal considerations producers have when selecting a site and deciding on a manure management practice. Existing data on production costs and manure management practices, along with a region's regulatory environment, are used to determine whether a region has a competitive advantage. The data indicates that the historical advantage of the North in hog production has diminished in recent years.

An international perspective provides a six-country review similar to the domestic analysis. Due to high nitrate levels in several countries, manure management and supply controls feature prominently in current regulations. The study also finds that any advantage the U.S. has in lower production costs is limited by trade distortions.

The conclusion of this report is that no definitive relationship can be identified among environmental regulations, manure management practices, and production costs using available data. This study clearly indicates the need for more precise data on the cost of compliance, manure management practices, and production costs.
The pork industry is a vital enterprise, both to the U.S. and especially to the state of Iowa. For over 100 years, Iowa has been the leading hog producing state. In the first quarter of 1998, Iowa had a 23 percent share of total hog inventory in the U.S.¹ Pork production and processing supports 89,000 jobs and contributes $3.1 billion per year to Iowa’s gross state product.² Although Iowa is a significant pork producer, at least 75 percent of production takes place in other states, making the pork industry an important part of the U.S. economy. Exports of pork products are also a substantial contributor to national employment and income. According to Iowa’s Pork Industry — Dollars and Scents, pork exports were about 8 percent of 1997 U.S. pork production, and the USDA projects that U.S. exports of pork products will double over the next 8 years.³

Even though the pork industry is thriving nationally, the geographic distribution of pork production within the U.S. shifted from 1992 to 1996. For example, Iowa’s total hog inventory fell 18 percent. The total hog inventories in Oklahoma, North Carolina, Minnesota, and Kansas increased by 386%, 107%, 3%, and 1%, respectively. Utah, Wyoming, and Colorado experienced increases of 270%, 134%, and 54%, respectively. Other states, such as Indiana, Illinois, and Wisconsin had decreases of 18%, 25%, and 34%, respectively.⁴

Several states and countries have recently revised their regulations concerning concentrated animal feeding operations for a variety of reasons. “The major driving forces

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have been, and continue to be, environmental concerns about water quality and odors, structural and social concerns over vertical and horizontal integration trends, and economic issues such as adding value to agricultural products and competing with other states and countries to become the most efficient producers of pork in the world". This report focuses on the regulatory environment that pork producers face as one of the factors that is influencing the changes in the geographic distribution of pork production in the U.S. and in the international market.

Iowa’s dominance in the pork industry may be due to “excess packer capacity and abundant feed grain supplies." Historically, the Corn Belt has enjoyed lower costs and higher revenues than other regions of the U.S. In recent years, however, larger farms and more advanced production technology “have been used by the swine industry in non-Midwestern states to overcome feed and hog price disadvantages.”

It is not clear that the U.S. has a distinct advantage in the global pork market. While there are other regions in the world that have lower priced feed grains, the established processing and transportation systems in the U.S. may result in a comparative advantage for the U.S. However, Brazil, Argentina, and Eastern Europe may increase the level of competition in the world pork market because of excess grain production. Furthermore, the U.S. is at a disadvantage because of its geographic distance from the Pacific Rim. This

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distance leaves opportunities for Southeast Asia and Australia to increase their market share which may threaten U.S. pork exports to the Pacific Rim.  

This background raises several questions regarding both the U.S. and world pork industries:

- How important are the differences in environmental regulations between states and countries?
- How significant are the costs of environmental regulations to producers?
- Do variations in manure management practices significantly change production costs across states and countries?
- How do differences in overall production costs affect competitive advantage across states and countries?

UNITED STATES PORK INDUSTRY

There are important qualifiers that need to be shared. First, while some of the available information is not current, it is useful in relative comparisons of production costs and returns as well as in manure management and production practices by region and size of operation. Second, the current regulatory environment in the U.S. is very dynamic and uncertain. Thus, it is not possible within the time and resources available to develop quantitative estimates of the impacts of environmental regulations on interstate location decisions of large pork firms. Rather, the responses from select large producers are summarized.

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Environmental Regulations

To assess the environmental regulations of pork production in the U.S., key elements of current regulations in five states (Iowa, North Carolina, Minnesota, Kansas, and Oklahoma) were reviewed. These states have either significant hog production or recent growth in hog production. A summary of the elements is contained in Table 1.

- Construction and operation permits for new and expanding facilities are required in all the states in the study. The exception is Iowa, where operation permits are not required.
- As part of the site investigation prior to construction or expansion, testing to determine the depth of groundwater and soil permeability may be necessary. Soil boring is required in Iowa, North Carolina, Minnesota, and Oklahoma.
- Seepage limits vary from 1/56 to 1/8 of an inch per day. Oklahoma is the only state without seepage limits.
- Because manure is usually applied to cropland as fertilizer, amounts of nitrogen and phosphorus in the manure are important. All the states in the study have instituted regulations for land application of manure.
- All of the states examined required separation distances between permitted facilities and both neighboring water supplies and residences.
- Specific regulations regarding odor control are generally encompassed by manure management plans requiring the use of “best management practices” or set back requirements.
- Periodic inspections to review compliance with current regulations have been implemented in all of the states studied.
- Three of the states in the study, Oklahoma, Kansas, and Iowa, have financial assurance for closure to insure proper clean up of manure on the site. The assurance programs include state indemnity funds, producer bonds, or demonstration of producer’s ability to pay. Minnesota allows (but does not mandate) each county to implement a financial assurance program.
The last row of Table 1 shows the most recent major legislative initiatives of the states. In 1998 Kansas and Oklahoma passed sweeping reform of their environmental regulations for animal producers. In 1996 North Carolina instituted a moratorium on new and expanding facilities. In 1996 Iowa passed House File 519 which increased standards for producers and most recently passed House File 2494 which significantly amends the regulations for confined animal feeding operations.

**Manure Management Practices**

A 1996 survey by the Iowa Agricultural Statistics Service for the Department of Economics at Iowa State University gives detailed information about the manure management practices of producers in Iowa. Thirty-one percent of manure is handled in solid form, while the remaining 69 percent is handled in the following manner:

About 36 percent of the manure was generated from market hogs on deep pit systems, 7 percent from hogs on outdoor earthen basins, 9 percent from outdoor formed storage (concrete basins or above-ground steel tanks), and 7 percent from anaerobic lagoons. The remaining 9 percent of manure was generated from hogs on other systems, primarily pasture systems.9

A more complete report of the survey can be found in *Iowa’s Pork Industry – Dollars and Scents*.

The types of manure storage systems that were utilized at various capacity hog operations within regions in 1992 is shown in Figure 1.10 These numbers do not represent the current situation in the pork industry but are the most recent data available. The majority of large hog operations in the South Atlantic and South Central regions used

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10 The 1992 FCRS defined the following regions. South Atlantic and South Central: Virginia, North Carolina, South Carolina, Georgia, Alabama, Tennessee, Kentucky, and Arkansas. Lake States and Corn
lagoons to store manure. The other regions (i.e. Lake States and Corn Belt, and Plains States) predominantly used manure pits for manure storage. According to the 1992 Farm Cost and Returns Survey (FCRS)\textsuperscript{11}, the most common form of storage was “none of the above” (i.e., neither lagoons not pits) for operations with capacity of less than 500.

The most recent national data for the percentage of manure that was handled in liquid and solid form are the 1992 FCRS conducted by the USDA (Figure 2). The results of this survey indicate that as the size of operation increases, a larger share of the manure is handled in liquid form. Also, as hog producers get larger, they tend to pay more attention to the nutrient content of manure that is applied to crop land and make adjustments in commercial fertilizer rates. This cycle creates an efficient system for hog production in the Midwest region. Among the smallest operations, producers in the South Atlantic and South Central regions handle a larger share of manure in liquid form and producers in the other two regions handle a larger share in solid form. Although it is tempting to attribute these differences, at least in part, to environmental regulations, other factors have a more important role.

Two factors that are important in explaining the choice of manure storage used by producers are the climate and the soil type. Anecdotal evidence from North Carolina and Iowa is consistent with computer generated estimates which indicate that the average cost of constructing a lagoon is significantly lower in North Carolina. Hoag and Roka cite the 1985 Midwest Plan Service’s Livestock Waste Facilities Handbook estimate that a lagoon in Iowa would have to be 30% larger than in North Carolina to achieve the same...
treatment level because of the warmer winters found in North Carolina. The cost of excavation in Iowa is 80 percent more than the cost in North Carolina. The cost of lining a lagoon in Iowa is nearly twice the cost in North Carolina. Furthermore, North Carolina has an advantage in the large amounts of clay naturally occurring in the soil, thus eliminating a potentially large cost component of constructing a lagoon.

The soil type is also an important issue in explaining the manure storage choice of these regions. The fertile soil in Iowa is particularly well suited for growing corn, while North Carolina’s soil is more suited to growing hybrid bermuda grass (hay), tobacco, and peanuts. The high yielding corn in Iowa uses the nutrients found in manure at higher rates and therefore makes slurry systems (manure pits or holding tanks) more efficient, because the concentration of nutrients (N and P) per load is increased. Utilizing manure in this manner also reduces the need for commercial fertilizer applications. These differences offer an explanation of the wider use of lagoon storage systems found in the South.

In the future, as the regulatory environment changes, producers’ options for manure storage systems may be limited. One estimate of the increased cost of compliance can be derived from the increased size requirement of lagoon storage systems. North Carolina’s 1996 legislation increased the freeboard requirements of lagoons. As a result lagoons must be on average 1/3 larger than before the legislation. In Iowa there is pressure to move away from lagoon storage systems to under building pits or above ground storage tanks. A telephone survey of engineers, contractors, and producers from

11 The USDA-ERS is currently conducting an updated FCRS focusing on hog farms. No release date is available.
13 Ibid. p 165.
the state of Iowa regarding the construction costs of manure storage facilities was conducted. The data for lagoons indicate a constant average cost relationship between the excavation cost of a lagoon and the number of finishing hogs. A small number of those surveyed provided cost estimates for under building pits by the number of finishing hogs. These data are summarized in Figure 3. Lagoon systems are less expensive to construct than under building pits for all sizes of operations. States where lagoons are allowed and advantageous because of climate and soil type may have an advantage over states which ban the use of lagoons for manure storage.

Production Costs and Competitiveness

Cost and returns of hog production in the U.S. are available from the USDA on an annual basis. Figure 4 has four panels showing the value and cash expenses ($/cwt sold) of a farrow-to-finish operation in the North and South Regions from 1982 - 1996. The gross value of production was higher in the North until 1993. Total variable cash expenses are lower in the North for the entire time period. The lower total variable cash expense is, in part, due to lower feed costs in the North. The lower costs made the farrow-to-finish operations in the North more profitable, with the exception of 1996.

The USDA’s 1992 FCRS gives a point in time view of the costs and returns by region and size of operation. Figure 5 shows the profits by region and size from the 1992 FCRS. Based on this survey, larger operations are more profitable, especially when economic profits (which include the returns to risk and management) are compared. There is only a small difference across the regions of the Lake States and Corn Belt (labeled Corn Belt) and the South Atlantic and South Central States (labeled South). In the largest size
operations, the Southern states have a $3.07 (per cwt sold) cash advantage over the Corn Belt region. The difference in economic losses (i.e. negative profits) is smaller, $1.42 less negative in the South.

The cost of hog production was also estimated in a Purdue University Extension publication. Table 2 shows the production cost results of this study which also indicate lower costs for larger operations. The researchers cite technology as a primary reason that larger operations have lower costs. They also point out that smaller operations can benefit from adopting new technology. Capital costs for each of the 5 operations are shown in Table 3.

As the largest pork producer in the North, Iowa exemplifies the reasons for the North's history of lower costs. As summarized in *Iowa's Pork Industry — Dollars and Scents*:

Iowa's dominance in the pork industry in no accident. The state has relatively low priced feed grains and relatively high prices for hogs. Iowa producers also have the ability to use the manure nutrients as a fertilizer resource rather than a waste with the related disposal costs. However, the state's cost advantages have been offset by technological advances by some producers in other regions and by the construction of new processing facilities in these regions, not because of any natural advantages found in these regions. (16)

The states in the South experienced rapid growth in this industry in part because hog production allowed a more profitable use of relatively low valued land. In addition, farmers in the South were already familiar with contracting, which allowed large firms to enter the region and provided a stable source of income for independent farmers. (16)

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16 Telephone interview with Kelly Zering, Department of Agricultural Economics, North Carolina State University.
WORLD PORK INDUSTRY

Environmental Regulation

This study compares six countries with the U.S.: the Netherlands, Belgium, Denmark, Poland, Taiwan, and China. The Netherlands, Belgium, and Denmark have more extensive environmental policies than the U.S. Environmental regulations threaten the competitiveness and expansion of the hog industry, especially in the Netherlands and Denmark. Most hog producing regions in Northern Europe have been designated as "vulnerable" regions in the sense that nitrate concentration in their water exceeds 50 PPM and their nitrogen applications (manure and fertilizer) are above the 170 kg of residual nitrogen per hectare-year prescribed by the 1991 EC Nitrate Directive. Poland, whose integration with the EU is projected, is already in compliance with the nitrogen applications standards of the Directive. Taiwan set its own standards with the 1991 National Water Pollution Control Act Amendments. However, there are still concerns regarding water quality, which are likely to result in further regulation of the livestock industry.

Production Costs

In all the studied countries, traditional cost components and implicit production subsidies/taxes (trade distortions) help determine the competitive advantage in the hog industry. Unit cost varies widely across countries, but the shares of various cost components do not. Feed cost usually accounts for 50 to 60 percent of unit cost. Labor cost is slightly less than 10 percent of unit cost in most countries, and the opportunity cost

17 Unless otherwise noted, the information on the World Pork Industry is from Beghin, John and Mark Metcalfe "Environmental Regulation and Competitiveness in the World Pork Industry" mimeograph. Iowa State University.
of capital is between 15 and 30 percent of unit cost. Capital cost is influenced by manure storage requirements, but the latter component appears to be small, based on the evidence from the U.S., the Netherlands, and Taiwan. Location with respect to final consumer/export markets and trade distortions at the border of the importing country are also important. The costs of production across countries are difficult to compare because countries tend to produce different quality pork products, have different phytosanitary conditions, and occasionally have disease outbreaks that may be disruptive.

International Competitiveness

Generally, the U.S. has a competitive advantage based on lower labor and feed costs. In the aggregate, the U.S. benefits from low population density and land availability. A segment of the U.S. hog industry benefits from economies of size in hog production with integrated, large operations. Large exchange rate movements influence the international competitiveness of U.S. hog products and may overshadow production cost components, such as environmental regulation.

Taiwan was competitive internationally until 1997 when an outbreak of foot-and-mouth disease compromised exports indefinitely (i.e. export demand collapsed). The international competitiveness of Taiwan was narrow, limited to the Japanese market and to a lesser extent, Hong Kong. Taiwan has low cost processing, which is comparable to the U.S.

As noted in Iowa's Pork Industry – Dollars and Scents, China is the largest pork producing country and has both high and low technology production facilities. However, China's low technology facilities produce a lower quality product, while the high
technology facilities are hampered "by poor feed conversion, disease problems, and expensive feed costs".  

Poland does not appear to be competitive in broader international markets (e.g. unit cost is high, animals are of lesser quality, feed conversion is poor, farms are small, processing is antiquated). The consensus view is that Poland will not be internationally competitive for several years. The proximity to the former Soviet Union and Europe is the only tangible advantage for Poland. Poland may benefit from a perceived carrying capacity constraint in Northern Europe. European production could eventually relocate to Poland if the other cost disadvantages can be overcome.

European producers are competitive in the sense that they produce a high quality product, which meets final consumer preferences in several export markets (e.g. intra-EU, Asia). The Netherlands have had a decrease in the export demand for pork due to an outbreak of Swine Fever. Processing is advanced, but more costly than in the U.S.

European agricultural policy and trade barriers benefit European producers. The Common Agriculture Policy (CAP) makes European producers pay higher prices for feed, and they also face higher labor cost than most foreign competitors. Import duties keep U.S. producers out of the EU market, and export subsidies are significant. Both have been decreasing because of commitments under the Uruguay Round agreement of the World Trade Organization (WTO). The implementation of the WTO agreement will progressively reduce the protection of EU hog producers by lowering the import duties on pork imports, and by increasing minimum market access for non-EU producers. The latter

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will benefit Central European Free Trade Agreement countries (Poland, Hungary, Czech Republic, Slovenia and the Slovak Republic) rather than the U.S.

Exports of pork products from the U.S. to some Southeast Asian countries and Mexico are expected to increase over the next 10 years. The principal international competition for these markets is expected to come from Canada and subsidized East European countries, as noted in *Iowa's Pork Industry — Dollars and Scents.*

**CONCLUSION**

**Are there differences in environmental regulations across states?**

The regulatory environment varies by the stringency of the regulations across states. The states with rapid growth in hog production did have limited regulations (and greater ease of meeting environmental standards because of more favorable geophysical conditions). It is also important to note that most states have recently revised their regulations regarding confined animal feeding operations. In 1998 Iowa, Kansas, and Oklahoma passed significant reform of their environmental regulations for animal producers. In 1996 North Carolina instituted a moratorium on new and expanding facilities. These changes in the regulatory environment may provide incentives for large producers to relocate to areas with less restrictive environmental regulations.

**Are the costs of environmental regulations significant to producers in the U.S.?**

While concrete data do not exist, anecdotal evidence from large producers indicates that they do consider states’ environmental regulations when determining their future production plans. However, their consideration is based more on the uncertainty about
future regulations than the current regulatory environment. Producers attempt to predict future regulations and build more expensive facilities that comply with those forecasts. Even with these efforts large producers are having trouble maintaining compliance in several states.

Do manure management practices vary across states?

The available data indicate that manure management practices do vary across regions and size of operation. Despite the temptation to attribute these differences to the variation in environmental regulation and cost of production, no clear connection can be drawn from this research.

How do differences in production costs affect comparative advantage among states?

Until recently, the North had a cost advantage in pork production, which can be attributed to the geographic proximity of the feed grain – mainly corn and soybeans. This proximity is also advantageous because corn utilizes more of the nutrients found in hog manure than other grain crops. The *Iowa’s Pork Industry — Dollars and Scents* report notes that, “[A]s hog producers get larger, they pay more attention to the nutrient content of their manure and make adjustment in their commercial fertilizer rates.” This cycle creates a more efficient system for hog production. However, technological advancement and newly constructed processing plants in the South have closed the cost differential between the two regions.

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Are there differences in environmental regulations across countries?

The countries in our study are experiencing a level of change in their environmental regulations similar to that of the U.S. The focus of the new regulations is on controlling disease outbreaks and protecting water quality.

Are the costs of environmental regulations significant to international producers?

It is likely that producers will be subject to more stringent standards regarding manure storage and application. Environmental regulations are evolving toward direct supply control in Northern Europe, which may compromise exports and expansions.

How do differences in production costs affect countries' competitive advantage?

The competitive advantage of the U.S. is presently based on lower labor and feed costs. However, this advantage is limited by the trade distortions of other countries. In the future, the implementation of the WTO agreement will progressively reduce the protection of EU hog producers by lowering the import duties on pork imports and by increasing minimum market access for non-EU producers.

Concluding Remarks

The questions this study endeavored to answer require complex answers. Given the time and resource constraints, existing data was utilized to its fullest extent in an attempt to answer the questions posed. This study clearly identifies the need for definitive data on manure management and cost of compliance.

Given the fluctuating regulatory environment, it is not clear whether any state has or will have a competitive advantage in the production of pork. In recent years, the differential in gross value of production less cash expenses between the North and South
regions has diminished. Our study, however, shows no conclusive evidence that this trend is or is not the result of changes in legislation.
<table>
<thead>
<tr>
<th>Issue</th>
<th>Iowa</th>
<th>North Carolina</th>
<th>Minnesota</th>
<th>Kansas</th>
<th>Oklahoma</th>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Operation Permits</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Soil Borings</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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<td>Seepage Limits</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<td>Inspections - Periodic</td>
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<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<td>No</td>
<td>No (local control)</td>
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<tr>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<td>Manure Management Plan</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (&gt;1000 au)</td>
<td>Yes</td>
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<td>Spill Contingency Plan</td>
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<td>Unknown</td>
<td>No</td>
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<td>Yes</td>
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<tr>
<td>Most recent major Legislative Initiatives</td>
<td>H.F. 519 (May '95)</td>
<td>Moratorium on expansion 1996</td>
<td>S.F. 3353 (April '98)</td>
<td>H.B. 2950 (April, '98)</td>
<td>S.B. 1522 (May, '97)</td>
</tr>
</tbody>
</table>

21 Using program features as of 1998.

<table>
<thead>
<tr>
<th>Size</th>
<th>150 - Low Tech</th>
<th>150 Sow High tech.</th>
<th>300 Sow</th>
<th>600 Sow</th>
<th>1200 Sow</th>
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<td>Feed Cost</td>
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<td>19.80</td>
<td>19.80</td>
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<td>Direct Cost</td>
<td>25.33</td>
<td>23.29</td>
<td>23.37</td>
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<td>22.07</td>
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<td>Indirect Cost</td>
<td>22.55</td>
<td>17.25</td>
<td>15.26</td>
<td>13.64</td>
<td>12.17</td>
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<td>Total Cost</td>
<td>47.88</td>
<td>40.54</td>
<td>38.63</td>
<td>35.72</td>
<td>34.25</td>
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</table>

Table 3: Capital Costs. Source: *Positioning Your Pork Operation for the 21st Century*, Purdue Univ. Extension, 1995.\(^{22}\)

<table>
<thead>
<tr>
<th>Size</th>
<th>150-low tech</th>
<th>150-hi tech</th>
<th>300</th>
<th>600</th>
<th>1200</th>
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</thead>
<tbody>
<tr>
<td>Total Capital Costs</td>
<td>$480,919</td>
<td>$505,798</td>
<td>$985,727</td>
<td>$2,050,847</td>
<td>$3,817,939</td>
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<td>Cost of Manure System</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>$142,701</td>
<td>$268,147</td>
</tr>
<tr>
<td>Manure Handling System</td>
<td>deep-pit manure management w/ injection</td>
<td>deep-pit manure management w/ injection</td>
<td>Deep-pit manure management w/ injection</td>
<td>72,972 yd(^3)</td>
<td>145,931 yd(^3)</td>
</tr>
</tbody>
</table>
<pre><code>                          | 3-stage lagoon, w/ irrigation               | 3-stage lagoon, w/ irrigation               |                           |                     |
</code></pre>

\(^{22}\) All facilities are located in the mid-west.

\(^{23}\) Number of sows in a farrow-to-finish operation.
Figure 1: Manure storage. Percent of farms within region and capacity (head). Source: USDA-ERS unpublished calculations from the 1992 FCRS. (Note: Farms may have multiple storage facilities, therefore, the sum of the percentages within region and capacity can exceed 100.)

24 The 1992 FCRS is the most recent data available. These data are not intended to represent the current state of the pork industry but do illustrate the distribution of manure storage systems that are most prevalent by region and size of operation.
Figure 2: Manure Handling: Percent of manure handled by each method. Source: USDA-ERS unpublished calculations from the 1992 FCRS.²⁵

²⁵ The 1992 FCRS is the most recent data available. These data are not intended to represent the current state of the pork industry but do illustrate the distribution of manure handling systems that are most prevalent by region and size of operation.
Figure 3: Manure Storage Facility Average Construction Costs per Finishing Hog

The small sample size may not present an accurate measure of the average cost for manure storage facilities. Under building pit costs include concrete and slats only. Lagoon costs include excavation and liner costs only.
Figure 4: Cost and Returns, by region, 1982 – 1996. Source: USDA-ERS FCRS annual survey.
Figure 4: continued

Gross Value of Production less Cash Expenses (Farrow-to-Finish)

Year

$cost / $sold


North
South
Figure 5: Cash and Economics Profits. Source: USDA-ERS 1992 ERS, unpublished calculations.

<table>
<thead>
<tr>
<th>Year</th>
<th>Region</th>
<th>GVP Less Cash Costs</th>
<th>GVP Less Economic Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Plains</td>
<td>-11.72</td>
<td>-10.72</td>
</tr>
<tr>
<td>1999</td>
<td>Belt</td>
<td>-11.72</td>
<td>-10.72</td>
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<td>-12.0</td>
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<td>-27.73</td>
<td>-28.13</td>
</tr>
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**Notes:**
- GVP = Gross Value Plus
- Cash costs include: production, marketing, and management costs.
- Economic costs include: production, marketing, management, and opportunity costs.