

Environmental Regulation and Competitiveness in the Hog Industry
An International Perspective

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Introduction

This paper is based on a study reviewing environmental regulations affecting the hog industry in The United States, several European Union (EU) countries (Belgium, Denmark, Holland), Poland, and Taiwan (see appendix attached for review). The study further assesses the competitiveness of the hog industry in these countries, focusing on the key determinants of competitiveness including the impact of environmental regulations. In the next section, we summarize findings on environmental regulations in these countries, including an environmental stringency ranking, and then we draw implications for their competitiveness in hog production and trade in hog products. In the appendix, we review each country's waste and environmental regulation and its competitiveness in hog production.

Worldwide, the hog and pork industries are undergoing major structural changes, as well as changes in their regulatory environment. Some of these changes are country-specific, while others are global in nature. In the United States, several new sources of international competitiveness have arisen in conjunction with these changes. Beside the traditional feed and labor cost as a source of comparative advantage in the U.S. hog industry, early evidence suggests that the new industrial organization into large farms is a major source of competitiveness. In addition, it appears that environmental compliance cost in the U.S. hog industry may be lower than the cost faced by some of its EU competitors.

The recent growth in global trade in pork products is a major change, which feeds back into the organization and competitiveness of the hog industry. In the United States, new economies of scale and economies from information coordination have arisen with the emerging industrial

organization of the hog and pork industries, especially with new large operations. The new and large operations are associated with improved hog-processing technologies and reduced processing and transportation cost. These coordinated operations (hog/pork) are rapidly replacing smaller sole-proprietor hog enterprises in the traditional hog-producing states. The U.S. hog industry's transformation is guided by the competitiveness of the large operations including the cost of waste management, which differs by farm size and by state since climate, soils, demographics, and many regulations are state-specific.

The size of hog operations appears to affect the cost of waste management as well. A current conjecture is that large operations meet environmental standards at a lower cost than small traditional operations, because capital cost and environmental expertise expenditures are spread over a larger output. This conjecture is consistent with the massive relocation of production, which has been occurring geographically and towards large operations.

These recent developments in the industrial organization of U.S. swine products industries are changing international trade patterns in hog and pork products between the United States, the European Union and Asia. Coincidentally, several Asian countries and Holland have just recently faced adverse phytosanitary conditions, which have dramatically put in question the long-term competitiveness of their previously well-established hog industries. This unexpected shock can be considered as an exogenous supply reduction in world markets, which creates new export opportunities for U.S. hog producers and processors.

Until recently, the European Union, especially Holland and Denmark, have benefited from the expansion of pork consumption in Asia (Japan, South Korea, and expected in China), which was induced by the long-term sustained income growth that occurred in these countries. With lower cost of production and improving quality, the United States is becoming a very efficient

producer of hog/pork products and is becoming a net exporter of swine products, in contrast to its traditional net importer status, and it has become a threat to EU competitors. Increased pork demand in Asian countries, combined with packaging innovations that have reduced transportation costs, have increased the demand for imported pork from the US. There is every reason to believe in the long run that the demand for U.S. products will continue to grow on world markets despite the current Asian crisis, especially in Asia, but also in Russia following the Eastern bloc collapse. The United States is now a net exporter of pork.

Worldwide, environmental concerns linked to swine production are increasing. For example, in the EU, especially in Holland, Belgium, and Scandinavia, concerns about waste disposal are likely to force producers to adopt costly waste management techniques, or to scale back their production capacity. The U.S. hog industry is not immune from similar pressure, but its compliance cost is relatively lower than the cost increase faced by their EU competitors. The lower geographical concentration of the U.S. industry in a land-abundant country mitigates the cost associated with waste management and the perceived constraint on environmental absorptive capacity.

Within the United States, major swine producing states have been facing increasing costs to meet new environmental standards, which vary by state. Concerns that past swine waste management regulations have not been adequate to protect water supplies and air quality have induced a tightening of standards in many states (for example, Iowa and North Carolina). But this national trend has differential effects on states' swine industries because a) standards vary by state and are increasing at different rates, and b) the cost of meeting environmental standards differs spatially. Geographical and ecological conditions (climate, soils, water tables, for example) vary dramatically across states. There is also a concern that some regulations have been motivated

politically to protect existing small farms by prohibiting new large farms on environmental grounds.

U.S. producers in the Midwest (Iowa, Missouri, Nebraska and others), in North Carolina, and in the West (Colorado, Oklahoma, Texas, Utah, Wyoming) are not immune from new environmental cost, but their compliance cost may be relatively lower than for their European and Asian competitors. Large differences may exist however, across states and among producers. Based on early evidence, we surmise that, within any given state, those large operations may have lower cost of compliance (per unit of output). New producing states in the West tend to be less regulated because hog waste management is a new policy concern.

The Extent of Environmental Regulation

With respect to U.S. producers, Northern EU producers are the only competitors, in the set of countries considered, to be substantially affected by environmental regulation. In the context of potential international policy negotiations, EU producers would be the most likely supporters of a “leveled playing field“ in environmental regulation of hog production at the international level. These producing countries are extensively regulated and negotiated international regulations would not be binding for them. In summary, EU member countries, and especially Northern countries, have extensive and restrictive environmental policies, which have or will soon have a significant impact on the competitiveness of their hog industries.

Holland and Denmark are the most affected. The current direct cost of environmental regulation (waste handling and treatment, manure production rights, ammonia reduction) is still manageable, but is rising in these two countries. From available estimates, the direct cost of regulation in Holland (manure rights, waste treatment, building and storage requirements) is between 5 and 10 percent of unit cost, but could go much higher if nitrogen and phosphate

emissions were virtually eliminated (up to 24 percent of unit cost).

Most hog producing regions in Northern Europe are “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. These unmet criteria should induce and are inducing more drastic policies in these countries to be in compliance with the EU regulation. The new policies do not always impact cost directly, but increasingly limit output and export expansion (e.g., manure and ammonia production rights in Holland and more recently mandated direct herd reductions in Holland). A consensus seems to emerge on these countries having nearly reached their carrying absorptive capacity for animal waste. In Holland the recent outbreak of classic swine fever is allegedly blamed on the livestock concentration, especially in manure-surplus regions. The phytosanitary problem is perceived as being linked to “excessive” livestock activity.

Belgium appears the least ready, of the three EU countries surveyed, to seriously tackle its water quality problem; it has resisted reduction in hog production because it is privately profitable. Small hog producers are facing less environmental regulation than large-scale operations, in an effort to “preserve the small farm”.

The situation in Denmark is not as extreme as it is in Holland, but it is quite serious. Land-use requirements (manure/land ratio) and operation permits constrain expansion of Denmark’s hog production. The creation of operations larger than 15,000 heads is now prohibited in Denmark. These direct controls limit export expansion possibilities. Policies, which would not limit output, but which would require the elimination of nitrogen and phosphate emissions, would be prohibitive in Northern Europe as well.

Taiwan and Poland, the two non-EU producers surveyed in the study, have limited or

negligible regulation of hog waste. Water quality is becoming a consumer concern in Taiwan and current regulation defines modest water quality standards.

We suggest a ranking (see table) of the importance of environmental regulations in the countries that we reviewed. The ranking is ordinal, and it does not imply that comparative advantage follows a similar order.

ENVIRONMENTAL STRINGENCY RANKING
<u>Very restrictive</u> (waste regulation (storage requirements), manure spreading regulations, waste and pollution quotas, required land /manure ratio, output quotas, water quality standards): Holland, Denmark
<u>Restrictive</u> (extensive waste and manure spreading regulation, but no direct quota on waste or output, water quality standards): Belgium (Flemish region), United States (Colorado for mega operations (5,000 heads); North Carolina; Iowa (large confinement operations); Illinois for mega operations (7,000 heads); Missouri; Nebraska (depending on regional resource district))
<u>Moderate</u> (limited regulation on waste regulation/treatment, water standards): Taiwan, some United States (Colorado for smaller operations; Iowa for small open-feedlot operations; Illinois on smaller operations; Oklahoma, but likely to become more extensive; new producing states (Utah, Wyoming))
<u>Negligible</u> : Poland

International Competitiveness

In all countries, the comparative advantage in the hog industry is mostly determined by traditional cost components and by the presence/absence of implicit production subsidies or taxes arising from trade distortions. Unit cost varies a lot 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 below 10 percent of unit cost in most countries; and the opportunity cost of capital is between 15 to 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 for the US, Holland, and Taiwan. Location with respect to final consumer/export markets and trade distortions at the border of the imported country are also important. Finally, the efficiency of processing is also instrumental in determining competitiveness of hog producers since hogs are a derived demand from pork exports.

The demand-side determinants of competitiveness are the usual price and income responses. In addition, heterogeneous meat quality among competitors, including the phytosanitary status of the hog going into processing, are essential as well. Finally, exchange rate movements are important price shocks perceived (in local currency) by the importing country. The meat quality issue makes it hard to strictly compare cost of production because countries tend to produce heterogeneous pork products, including their phytosanitary characteristics.

It appears that phytosanitary problems, although rare, result in dramatic trade shocks, which dwarf any marginal environmental cost increment. For example, Taiwanese exports to Japan collapsed last year following an outbreak of foot-and-mouth disease and a 5-year export ban is anticipated. The recent outbreak of classic swine fever in Holland, which reduced its exports towards Asia, is another example.

The United States has a strong comparative advantage based on inexpensive feed and labor. The former varies by state and is the strongest in Midwest states. In the aggregate, the United States benefits from low population density and land abundance. The US, in aggregate, does not face the perceived carrying capacity constraint that Holland, Belgium and Denmark are facing. This observation abstracts from the important interstate relocation of production, which

has been taking place within the US, including away from NC. Finally, the most innovating segment of the U.S. hog industry benefits from economies of scale in hog production in the new integrated and large operations and is closing the quality gap with European competitors. However, large exchange rates movements, such as the recent and continuing appreciation of the U.S. dollars vis-à-vis Asian currencies, critically affect the international competitiveness of U.S. hog products and overshadow smaller cost components, such as environmental regulation.

Within the US, comparative advantage based on location varies significantly by state. For example, the Western states are better located for Asian markets than North Carolina and the Midwest states. Regulations vary considerably across states and evolve rapidly over time within some states (e.g., Moratorium in NC, new regulation in Iowa); the absorptive capacity varies by state (if not by county within state) as well, because of differences in population density, weather, and water resources and preferences. Differences in environmental regulation (their stringency) and absorptive capacity across states contribute to relocation of production capacity over time.

Absorptive capacity is an elusive concept however, because it is partly based on policy, which changes quickly overtime. Attempts to quantify the impact of regulations on competitiveness in various states have been frustrated by the difficulty to effectively quantify stringency of regulation. Stringency of individual policies is not additive over all policies, and it is hard to aggregate them consistently. Beyond this first hurdle, econometric identification of the effect of such regulation on hog production capacity by state has been defeated (See Metcalfe for further details). Beyond state regulations, counties have been adopting new zoning and environmental regulations, limiting location of hog operations within their jurisdiction, when local populations perceive federal and state regulation as inadequate. The quantification of these

new types of regulation has not been feasible yet, because of time lags and limited data. Hence, our “qualitative” approach is a palliative recourse awaiting more formal quantification.

European producers are competitive in the sense they produce a high quality product, which meets final consumer preferences in several export markets (intra-EU, Asia). Processing is also advanced, but costlier. The European common agricultural policy (CAP) and trade barriers benefit EU producers. 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 UR-WTO agreement. The CAP makes European producers pay higher price for feed and they also face higher labor cost than most foreign competitors. 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, although the later seems to benefit CEFTA countries rather than the US. Again the outbreak of swine fever in Holland has decreased the export demand for its pork products. Phytosanitary characteristics are an essential but overlooked component of quality.

Poland does not appear to be competitive internationally for many reasons (unit cost is high, animals are of inferior quality, feed conversion is poor, farms are very small, processing is antiquated). There is a consensus view that Poland will not be internationally competitive for several years. Proximity to the FSU and the EU is the only tangible advantage for Poland. Poland may benefit from the perceived carrying capacity constraint in Northern Europe and European production could eventually relocate to Poland if the other cost handicaps were overcome.

Taiwan was competitive internationally until last year when an outbreak of foot-and-mouth disease compromised exports indefinitely –export demand collapsed. The former international competitiveness of Taiwan was narrow, however, limited to the Japanese market

and to a lesser extent, to Hong-Kong. Taiwan has very low cost of processing, which is comparable to the US.

Worldwide, environmental concerns linked to swine production are increasing and environmental regulations are become more extensive, especially in the EU and to a lesser extent in the United States. Environmental regulations and limited absorptive capacity appear to affect competitiveness in Holland and Denmark, but it is premature to consider them as central determinants of competitiveness in the other countries surveyed. The phytosanitary status of herds is a more important determinant of comparative advantage although it is dichotomous. Traditional sources of competitiveness, such as feed and labor cost and cost of processing, remain pivotal. Farm size and associated economies are new determinants of competitiveness at the national level.

For Further Reading:

Beghin, J.C., and M. Metcalfe. "Environmental Regulation and Competitiveness in the Hog

Industry. An International Perspective," mimeo Iowa State University. August 1998.

Metcalfe, M. "Environmental Stringency and the Location of US Hog Production," mimeo, NC State University, June 1998.

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Appendix

Country Case-Studies

USA

Environmental Regulation

Federal Regulation

The Federal Government does not regulate the livestock directly, but instead has established regulations affecting water quality, especially with respect to non-point-source pollution. This review explains the recent evolution of this body of federal regulations. Then, the review describes the recent changes, which have been occurring at the state level.

Water quality has been an important regulatory concern in the United States since the inception of the 1972 Federal Clean Water Act. Regulation of NPS pollution was specifically addressed in sections 208 and 303(e) of this Act, and placed primary responsibility on states and local agencies for identifying NPS pollution and developing water quality management programs. The federal government's involvement was limited to providing funds and evaluating best management practices (BMP's) through the Environmental Protection Agency (US EPA). Aside from setting some basic water quality standards, most of the responsibility for the implementation of water quality programs and for the enforcement of the regulation of nonpoint sources was passed on to the states (US EPA 1994).

A motivation for the limited federal government's role in this original legislation concerns the difficulty in designing policy at the Federal level that is able to incorporated all the potential differences that can exist for site-specific water quality problems. Individual state governments are better equipped to deal with these types of local issues and are most likely able to work at the local watershed level more efficiently. A possible outcome of localized control is that it creates the opportunity for states to use lax environmental standards to attract polluting industries. While this may be most efficient in terms of allowing farms to locate in areas where

population is sparse or individuals do not have strong objections to the resulting pollution, this use of lax regulation can be a problem in the presence of effects that are external to the market.²

Concerns grew that state regulation alone did not provide sufficient protection for water quality. Non-point-source (NPS) pollution became regulated more stringently at the federal level through enactment of Section 319 of the 1987 Water Quality Act. This legislation introduced the National Selection Program, which allowed the Federal government to take a more active role in addressing NPS pollution problems. The Federal government increased its funding to states and more importantly increased its involvement in the approval of state NPS initiatives. These initiatives were in the form of state management plans that were required to include identification of the best management practices (BMP's) to be implemented and a timetable for this implementation. Section 319 of this Act also established US EPA funding grants to be distributed to states implementing US EPA approved NPS pollution control programs (Ribaudó 1991 and US EPA (1994)).

Federal involvement increased further when the United States Department of Agriculture (USDA) made a commitment to protect water quality from agricultural pollution through implementation of the 1990 Water Quality Program. In combination with the US EPA, and the Departments of the Interior and Commerce, this program provides research, education, and financial assistance for implementation of agricultural pollution management strategies. The USDA further increased their involvement in 1996 through implementation of the Environmental Quality Incentives Program (EQIP). The objective of the EQIP is to encourage less disruptive

² An example of such an externality would be if the environmental effects are transboundary and disrupt conditions in neighboring states or where poor water quality in rivers causes a lowering of coastal water quality and therefore affects many adjacent states.

agricultural practices to the natural environment. Half of the funds designated for EQIP will be targeted to address livestock pollution issues (USDA-ERS).

In May 1996, the US EPA and the states collaborated to create a National Nonpoint Source Program and Grants Guidance. While this is not an official piece of legislation, it is important program, because it suggests that the US EPA should play a larger role in providing both technical and administrative assistance to states designing NPS pollution programs. This is important in the history of NPS pollution legislation as it moves the US EPA closer to a partnership with states concerning the design and implementation of NPS pollution programs (see US EPA).

The most recent developments include the US EPA, acting under the authority of the Clean Water Act, to create federally mandated regulations concerning control of waste specifically from livestock farms. This type of Federal regulation could mean implementation of a national standard set across all states concerning a minimum base level of stringency and enforced Federally (Warrick 1998).

The above review of Federal legislation concerning NPS pollution from agricultural production shows the limited framework that has been provided in the past at the Federal level and also the current initiatives to increase Federal regulation. The lack of past involvement at the Federal level has allowed for current legislation at the state level that is varied and has been implemented mostly in response to chronic local problems such as excess nitrates in local water bodies. As of 1996, forty-four states had instituted some type of state program to address water quality issues by influencing agricultural production of NPS pollution (USDA-ERS (1997)).

Finally, there is a proposed bill in the Agricultural Committee, which intends to regulate concentrated animal feed operations (US Congress (1997)). The bill intends to make approved

waste management plans a requirement for animal operations. In addition maximum levels will be set for the release of nitrogen and phosphorus onto fields as well as minimum distances of these fields to private residences. Any waste, which can not be sprayed on fields, would be required to be treated to the same standards as human waste before it could be released into state waters.

State Regulations

Stringency of regulations seems to vary greatly across states and combined with the recent increase in regulatory efforts at the state and federal level makes identifying the current regulations on animal operations a difficult task. Most regulations seem to be only somewhat restrictive at this stage as they mostly are limiting the location of operations and not setting actual water quality standards. This situation could change drastically in the near future as more bills are appearing in the state and federal legislature to limit pollution from hog operations. A brief summary of some of these types of regulations follows.

Colorado implemented the Confined Animal Feeding Operations Control Regulation in August of 1992. This legislation distinguishes between animal feeding operations and concentrated animal feeding operations. Concentrated hog operations are those with more than 5000 head and these farms are subject to more stringent regulations. The requirements of animal feeding operations under this legislation are BMPs which divert runoff from uncontaminated areas. Concentrated feeding operations are not allowed any discharge of manure into waters of the state. The legislation encourages the beneficial use of manure and processed water such as its use in field application. (Walker).

Illinois has lenient regulations for separation distance of hog farms and public water sources. Only lagoons are required to meet certain standards. Restrictions of spraying include no

applications within 150 feet of wells and 200 ft of surface water. Strict manure management plans are required for operations with more than 7000 head. Operations with 1000 to 7000 head must also develop a plan, but the requirements are less stringent. Operations with less than 1000 head need not create a plan at all. Lagoon design is restricted to protect ground water.

Indiana has separation laws concerning the distance of hog farms from roads, wells, and streams. Manure application must not be within 200 feet of a well, 50 ft of a road, and 100 feet from surface waters. Management plans are required for all older facilities by the year 2000 and immediately upon construction for new operations. All facilities with more than 600 head have to create a plan. Lagoons and storage structures must satisfy certain design requirements to ensure protection of water quality.

Iowa until recently had little effective regulation constraining livestock operations. Most agricultural activities have been exempted from zoning laws and shielded from lawsuits for odor and other nuisances. In 1997, the state legislature passed a manure law (HF 519), and in 1998 a new regulations increase building requirement of permitted manure facilities (earthen manure storage). Open feed lot and confinement operations are distinguished. In general, open feedlot operations and especially small ones (less than 4000 hogs) are less regulated and scrutinized. Small open feedlot operations are exempted from permits and less scrutinized. All open feedlot operations have to remove “settleable” solids, cannot discharge waste directly in public lakes, water holes. Larger operations (more than 4000 heads) have to be permitted and build infrastructure to retain runoff for some prescribed period. Waste collected has to be applied to land to avoid ground water pollution, and when the feedlot is discontinued, waste has to be removed.

Still in Iowa, confinement-feeding operations are more regulated than open feedlot ones;

stringency of regulation increases with the scale of operation. The new regulation HF 519 has four components. It creates an indemnity fund to help counties with the cost of cleanup when operations fold without cleaning up; it increases construction permit requirements, it requires manure management and nutrient plans; and it beefs-up distance and setback requirements from livestock structures and manure applications. A fee assessed on confinement-operations started after 1985 funds the fund. The fee is \$0.1 per animal unit in large operations, less in smaller operations.(1 hog=0.4AU). Separation distances for manure field application are as follows. Manure may not be applied within 200 feet of designated areas such as wells, ponds, and lakes unless it is injected or incorporated in the soil. Additionally, spraying is restricted between 100 to 1000 feet along property boundaries and near buildings and residences. Manure management plans are required for all permitted facilities. These plans must detail the availability of the necessary land for manure disposal and application rates may not exceed that maximum agronomic nitrogen rate for the specific crop being grown. All permitted operations must be first be inspected by a qualified agricultural engineer in the design stage. The engineer inspects lagoon design and certifies that the distance of the lagoon to public water is sufficient given the waste system installed.

The state of Minnesota has little say in determining separation distances of operations from public waters as these regulations are usually managed at the county level. Regulation at the state level allows the farmer to construct his operation wherever he sees fit, given he can prove water quality will not be adversely affected. Manure management plans are required at the state level and are more stringent for larger farms. The agronomic nitrogen and phosphorus levels usually determine the amount of waste that is allowed to be sprayed. Minnesota does impose design restrictions of waste system in order to provide protection to the

surrounding environment.

The Missouri Clean Water Law states that the owner of a concentrated feeding operation must not allow any discharge of pollutants into the waters of the state. Concentrated operations in Missouri are those which feed livestock in buildings or on bare lots. All farms are expected to comply with this law regardless of the size of the operation, but only large farms are required to obtain permits. The first permit is a construction permit which is issued after waste management plans have been reviewed. The second is an operating permit which is issued after the management plan has been constructed to the initial design. Hog farms over 2,500 head must obtain the permits. Additional laws affecting concentrated animal operations have been presented in the state legislature. Restrictions include implementation of set backs, inspections, and more stringent zoning regulations (Missouri (1992) and (1996)).

Zoning of hog farms in Nebraska is controlled at the county level, but the state still has enforced separation requirements for hog operations. Farms must be located 100 ft from private wells and ground water and 1000 ft from public drinking supplies. The state has 23 natural resource districts which impose their own regulations concerning nonpoint source pollution. These districts regulate nitrogen entering the environment through enforcement of BMP's. Manure management plans are required for all permitted operations. As in other states, agronomic nitrogen is used as a determining factor in approval of the management plan. The individual districts are free to impose design limitations to protect water quality.

The State of North Carolina is the second largest producer of hogs and has seen the greatest increase in concentration of hog production in recent years. In August of 1997, the state enacted the Clean Water Responsibility Act (House Bill 515) to address increased water quality problems caused by nonpoint source pollution released from hog farms. The bill enacted a two-

year moratorium on hog production. During this two-year period information is to be collected to determine the extent of the damage cause to North Carolina's water through the release of hog waste. Zoning restrictions as well as suggestions to enact nitrogen and phosphorous limits are included in the bill. The nitrogen limit set for release of hog waste into surface waters is four milligrams of nitrogen per liter of wastewater. The phosphorus limit is set at an average annual mass load that would result from a flow with a concentration of two milligrams of phosphorous per liter. Allowances are included to lower these limits for water bodies which have less assimilative capacity. The bill also includes the intention of the state to determine economically feasible odor control technologies and requires their use by hog operations. (General Assembly of NC (1997)).

Oklahoma currently is proposing several bills that would lead to a moratorium on the construction of new corporate hog farms in the state (Oklahoma (1998)). Current legislation imposes restrictions on the location of operations with more than 2000 head near private residences and public lands and also restricts fields to which waste can be applied (Oklahoma (1998b)).

New producing States (Utah, Wyoming) were not extensively reviewed, but the consensus view is that the state regulations are limited, because the presence of the hog industry in these states is not yet perceived or contentious.

Cost of Regulation

When a state requires no discharge of manure or processed water a common alternative for the processed manure is the application to field crops. This manure is able to be used to offset some of the commercial fertilizer needs of farmers. Although, a low concentration of nutrients means costs of storage and transportation can be high when compared to commercial fertilizer

substitutes. Some studies have looked at these costs.

Flemming and Babcock provide estimates for application costs for manure obtained from slurry and lagoon systems in Iowa. These costs of application are a function of the type of transportation methods used and also whether or not the manure is incorporated in the field. Transportation of manure from a slurry system in Iowa is usually conducted through tanker trucks which haul the manure to the spray-fields. Lagoon systems are different as they are usually equipped with irrigation piping through which the manure is transported to the fields.

The average unit cost for mixing, loading, and unloading in dollars per gallon is reported as 0.0079 for hauling and 0.0057 for pumping. These values do not include the costs of incorporating the manure into the fields. The costs including the incorporation are 0.0088 for hauling and 0.0071 for pumping. The average unit cost for transportation abstracting from incorporation is \$0.0034 per gallon per mile for hauling and \$0.0028 per gallon per mile for pumping.

Zering provides estimated costs for a 4800 head finishing operation in North Carolina where the manure is applied to Bermuda grass hay. Cost Estimates are as follows:

<u>Item</u>	<u>Annual Cost</u>	<u>Cost Per Head</u>
Lagoon	\$5841	\$0.435
irrigation	\$6910	\$0.514
land	\$2688	\$0.2

All costs include depreciation and interest on initial construction investments (Zering (1996)). The land costs include interest and property tax on the land for the lagoon and the field to which the manure is applied. Irrigation costs will vary depending on crop type as manure must be applied differently. As an example, a cost estimate for manure application on corn for the same

4800 head farm includes \$7,780 in irrigation costs.

Zering also provides some estimates on the marginal impacts of reductions in the concentration of nitrogen in the manure, the size of the lagoon, and on the volume to be irrigated. A reduction in nitrogen concentration would allow for a 25% reduction in the required spray-field area which saves \$605 a year in the above example. The effect of the nitrogen reduction on the cost of irrigation is ambiguous. A 25% reduction in the required lagoon size would reduce costs by \$0.112 per hog while a reduction of 25% in the volume to be irrigated would save \$0.128 per hog.

Blauser et al. examine the costs of alternative manure handling systems for both feeding and breeding operations. They look specifically at paved lot and total confinement systems for finishing operations and partial housing and total confinement systems for breeding operations. The results of their study suggest that the paved lot system without runoff control when used for finishing operations costs \$41 per hog year for a 50 head farm while costs drop to \$6 per hog year for a farm with 1000 head. To translate the cost of a hog year into the cost per hog the authors assume that the hogs in the facility will be sold 2.5 times per year, which gives costs of \$16.4 and \$2.4 for the 50 and 1000 head operations respectively. If additional runoff controls are found to be necessary then costs can increase up to \$28 per hog for the 500-head farm and \$3.2 per head for the farm with 1000 head.

A finishing operation using a total confinement system can face costs ranging from \$11 to \$19 per hog year for a 200 head farm and \$1 to \$6 per hog year for a 1000 head farm depending on the specifics of the system. This translates into \$4.4 to \$7.6 per hog and \$0.4 to \$2.4 per hog for the 200 and 1000 head operations respectively.

Breeding hog operations using a paved lot with partial housing are estimated to cost

between \$94 and \$100 per sow year for a 20 head operation and \$22 to \$24 per sow year for a 100 head operation. The range of costs for a breeding farm with total confinement ranges from \$76 to \$176 per sow year for a 20 head operation and from \$31 to \$53 per sow year for a 100 head operation. The range of these costs is dependent on the need for additional runoff facilities and the specific design implemented.

References

Blauser, R.J., D.L. Forster, and G.D. Schnitkwy, "Costs of Alternative Hog Manure Handling Systems", Ohio Cooperative Extension Service, The Ohio State University, ESO 1777, October, 1990.

Dummermuth, M.M, "A Summary and Analysis of Laws Regulating the Production of Pork in Iowa and Other major Pork Producing States", Drake Journal of Agricultural Law, v. 2, pp. 449-84, Winter 1997.

Flemming, R.A. and B.A. Babcock. "Resource or Waste? The Economics of Swine Manure and Management", Iowa State University, 1997.

Fulhage, C.D., "Animal Waste Regulations for Livestock Producers in Missouri", University Extension, University of Missouri, WQ0200, 1992.

General Assembly of North Carolina , "HB 515 Clean Water Responsibility Act", 1997.

Jones, D.D. and A.L. Sutton, "US Annual Manure Management Regulations: A Review and a Look at What's Coming," in Getting the Most From Your Manure Resource: Managing Your On-Farm Animal Waste System, 1996.

Missouri State Legislature, "HB 1408"

Oklahoma House of Representative, "House Committee Reviews Proposed Limits On Concentrated Animal Feeding Operations", Media Division, January 27, 1998.

Oklahoma State Legislature, "Bill 2-9-210"

Ribaldo, M. and D. Woo, "Summary of State Water Quality Laws Affecting Agriculture," Agricultural Resources: Cropland, Water, and Conservation, AR-23, 1991.

US Congress, "USC Sec. 1329 Chapter 26 - Water Pollution Prevention and Control, Subchapter III-Standards and Enforcement", 1987

US Congress (105th Congress) "S. 1323 A Bill to regulate concentrated animal feeding

operations for the protection of the environment and public health , and for other purposes.", 1997.

USDA-ERS. "Agriculture and Water Quality" Technical Report, USDA-ERS, 1997.

US EPA, "National Water Quality Inventory - 1994 Report to Congress," Technical Report, USEPA, Office of Water, December 1995.

US EPA, "Nonpoint Sources, Picking Up The Pace, EPA's Draft Proposal Strategy for Strengthening Nonpoint Source Management," Prepared for Presentation by EPA at the Wye River Conference Center, 1997.

Walker, L., "Agricultural Engineering Technical Brief - Colorado Confined Animal Feeding Regulations: Who Must Comply", Cooperative Extension, Colorado State University, 1993.

Warrick, J. and P.S. Goodman, "US EPA Plans to Regulate Livestock Waste," Washington Post, March 5, 1998.

Zering, K, "What Does This Cost The Operation? Using Economics to Make Decisions on Nutrient Load", Presented at the National Pork Producers Council 1996 Pork Profitability Summit, December 11, 1996..

BELGIUM

Environmental Regulation

Pollution problems related to manure in Belgium are occurring in the northern region of the country (Belgian Flanders) where the animal production is concentrated. This review focuses on regulation in the Flanders. Quality standards were set in 1987 for surface water quality (nitrogen and phosphorus residues). In the late 1980's the Flemish Region put in place the Environment Policy Plan which contains the main guidelines for water quality with respect to nitrate and phosphate. Short term levels were set at 50 mg/l for nitrate and 5 mg/l for phosphate; long-term levels (to be reached by 2001) were set at 25 mg/l for nitrate and 0.4 for phosphate. The standards had to be met by 1995 but were not. The 1991 Flemish Manure Act constrains farmers' applications of manure and creates a Manure Bank and a Manure Problem Board to implement and manage the regulation. The first manure action plan was enacted in 1993 to achieve the long-term goals of the Act, and to conform to EU regulations (The 1991 EC Nitrate Directive).

Livestock farms have to obtain an environmental license. To obtain the license, they must prove that they have storage facilities for 6 month of manure and that they have sound disposal procedures. License renewal depends on the regional mineral production.

Standards are set for fertilizer application from organic and inorganic sources. No more than 400 kg of nitrogen per hectare-year has to be applied. By 2002, the applications will not exceed 420 kg for grassland and 275 kg per hectare of other crops. Maximum manure applications should not exceed 250 kg of nitrogen-equivalent per hectare of grassland and 170 kg per hectare of other crops. Current standards for phosphate are as follow: 200kg per hectare of fodder corn or grassland, and 150 kg for other crops. Starting in 2002, these application rates will fall to 120 kg and 100kg of phosphate per hectare, respectively.

These standards are not stringent enough to comply with EU standards (170 kg of residual nitrogen of all sources). It is expected that in the long run livestock supply contraction will be necessary to comply with EU directive in the Flanders. The farmers union in the Belgian Flanders is very powerful and linked to the Christian Democrats (Boerenbond). The reduction of output will be a contentious issue.

Since 1997, nonfamily farms are identified as farms with phosphate byproducts in excess of 6 metric tons per year, along with other criteria. Since a finishing pig year is equivalent to about 7.6 kg of phosphate, the 6-ton criteria corresponds to a capacity of about 800 pigs per year. These farms have to ship their manure long distance and cannot dispose of their waste within the municipality, or they have to process the waste before shipping it out. Practically this regulation is enforced in livestock-dense regions of the Flanders, but not everywhere. It is projected that by the end of 2002, farms with more than 10 metric tons of phosphate will have to process the waste before transporting it.

There are restrictions on manure applications. Manure cannot be spread between October and end of January, or on flooded, snow-covered or deeply frozen land. Manure has to be injected, sodden, or ploughed in within one day of spreading. Disposal of manure on uncultivated land is prohibited. Spreading is also prohibited at night, Sundays and holidays to restrict odor pollution.

Farmers have to keep nutrient/fertilizer balance sheets for phosphorous and nitrogen. The accounting has to include an inventory of minerals produced in manure and of their disposal methods and possibilities. Surpluses of minerals are taxed at BF 2 (US\$1=BF36) per kg of phosphate or nitrogen. The tax increases to BF 5 f per kg if the surplus rises above 10 tons of phosphate and 20 tons of nitrogen. The manure bank approves shipping from mineral-surplus

farmers to deficit farmers for disposal purposes. The market handles transport.

There is also a new phosphate regulation, which will increase levies on all phosphate emissions with tax rates from BF 2 to BF 25 per kg of phosphate emissions, or \$0.14 to \$1.75 per hog, depending on disposal, treatment and production.

75 percent of the excess manure in the Flanders come from pig farms (78 percent of farms specializing in finishing pigs exhibit excess manure). The Flanders are already ridden by excess nutrient problems from other agricultural activities. New restriction planned for 2002 will preclude exports of waste towards Wallonia, because of a national constraint. So processing will have to be considered. Processing separates solids and liquid parts. The processing has some fixed cost and some variable cost per ton of manure. The liquid part can be disposed on land or locally and the solid part can be shipped.

Cost of Regulation

Transportation of manure from surplus farms to manure-deficit farms is an important component of the cost of the environmental regulation affecting the Belgian hog industry. Cost estimates range from BEF 115 metric ton of manure to 222 BEF. These figures assume that all proposed transactions are accepted by the authorities under current nutrient application standards. Under more pessimistic assumptions (nutrient applications rates are decreased to 2002 levels), more sub-regions are in surplus and the cost of manure transportation rises quickly to BEF 519 per ton of manure, because transportation distances increase rapidly (Lauwers et al. (1995)). These costs translate into \$1.78 to \$3.42 per hog for the optimistic scenario and up to \$8 per hog under tighter application rates.³

³ We use the assumption that a finishing pig year produces about 1.7 metric ton of "pure" raw manure (urine + feces). Actual manure is likely to be more voluminous because cleaning water and rainwater are usually added to the raw manure. (We use the

Processing cost of manure prior to shipping is estimated at around BEF 500 per ton of pig manure, or about 7.7 \$ per hog.⁴

Surpluses of minerals are taxed at BF 2 (US\$1=BF36) per kg of phosphate or nitrogen. The tax increases to BF 5 f per kg if the surplus rises above 10 tons of phosphate and 20 tons of nitrogen. The manure bank approves shipping from mineral-surplus farmers to deficit farmers for disposal purposes. Presumably it is difficult to assess the tax on a per-hog basis in absence of a representative surplus figure for hog production. These taxes should increase land intensity of hog production, in order to decrease surpluses.

There is a new phosphate regulation, which will increase levies on all phosphate emissions with tax rates from BF 2 to BF 25 per kg of phosphate emissions, or \$0.14 to \$1.75 per hog, depending on disposal, treatment and production. Finally, there is some cost associated with the manure storage requirements. With the available cost information, it is difficult to disentangle the cost of manure storage from other capital and building expenses.

Summing up the different available cost components, the range of ball-park estimates for the regulatory cost per hog is as follows: A minimum of \$1.92 per hog for manure shipping and phosphate tax under optimistic assumptions to a maximum of \$ 5.27 under more pessimistic circumstances, but still under current regulations. Future regulations (2002 nutrient applications rates) could increase the cost up to \$17.75 (\$7.7 of processing, \$8 for transport, and \$1.75 of emission taxes). The latter estimate although imprecise because it does not include storage cost and the small surplus tax, conveys the considerable effect of future environmental regulation on hog production in Belgium.

assumption of 1.2 gallon/day of finishing hog , 120days of activity per pig and the usual conversion to the metric system) (Zering).

⁴ This figure assumes that a pig produces .554 metric ton of waste and that US\$ 1 equal BEF 36.

Factors Influencing Competitiveness.

Scale of operation is currently penalized through protection and assistance provided to small farms, although it has been shown that large farms in Belgium have lower nitrogen balance per unit of output, and have better feed conversion ratios (Lauwers). Large farms face higher cost of transportation for manure, however.

The EU supports its hog producers with internal support schemes, import protection and export subsidies. The internal scheme is essentially an aid to private storage, plus an intervention system, which is almost never used. The trade protection is more significant. Before The UR-WTO agreement, variable levies were used to keep competitors out of the EU. Currently, an average tariff equivalent based on carcass is used (68.7 ECU per 100kg of carcass weight in 1997-8 - ECU 1 = US \$ 1.134 in 1997). The tariff-equivalent has been decreasing over time. In 2000-1 it should reach 53.6 ECU/100kg. Rates per cut vary more dramatically (from 18.8 to 219 ECU/100kg in 1997). Imports under market access commitments are mostly benefiting Central European countries and they are marginal relative to output . Export subsidies are substantial, but have been decreasing and are progressively applied to lower quality cuts, which are less competitive on world markets. In 1997 export refunds were about 150 ECU millions, which correspond to an implicit subsidy of 33 ECU/100 kg of pork export or about 18 cents per exported kg of liveweight-equivalent. The CAP keep feed prices high and this is a major handicap for hog producers in all EU countries.

Belgium and especially the Flanders has a long tradition of hog production, processing and export. Products are of high quality, in the sense they satisfy final consumers' preferences in sophisticated markets like Japan. Belgian producers have recently benefited from the outbreak of swine fever in Holland and pork exports to Asia have increased, substituting for Dutch export

supply.

Unit cost of production decreases with scale of operation but the economy is not dramatic (from 48.5 BEF per kg of live-weight to about 36.5 BEF per kg of liveweight –no scale indicated). These figures are from Lauwers and they do not include labor cost, which would add about 3 to 4 BEF per kg (US\$ 1 = 36 BEF). Using USDA-FAS data on average weight of finishing pigs in Belgium we estimate the unit cost per hog as being in the range of \$134 to \$166.⁵ So Belgian producers appear competitive among EU producers with their unit cost being in the vicinity of \$1.16 to 1.44 per kg of live-weight), but would be at a disadvantage compared to US producers.

References

- Lauwers, L.H. "Competitive Pig Production in a changing Environment: an Analysis of Cost and Mineral Efficiency in Belgium," Mimeo, Centre for Agricultural Economics, Brussels, Belgium, 1998.
- . "Transportation Models for Supporting Location Dependent Manure Policy," *Belgian Journal of Operations Research, Statistics and Computer Science* 33(4) (1993): 3-15.
- , G. van Huylenbroeck. "Cost Effectiveness of Social Corrections in Flemish Manure Regulation" *Tijdschrift voor Sociaal Wetenschappelijk Onderzoek van de Landbouw* 12 (1997), 58-72.
- , -----, and L Martens. "A System Approach to Analyze the Effects of Flemish Manure Policy on Structural Changes and Cost Abatement in Pig Farming," *Agricultural Systems* 56(2) 1998: 167-183.
- ." "Internalizing eutrophication externalities by command-and-control measures in Flanders," in Hofreither, MF, and Vogels, S (eds.). *The Role of Agricultural externalities in High Income Countries*, Kiel: Wissenschaftsverlag Vauk, 1995: 195-208.
- Rude, S. and B.S. Frederiksen. "National and EC Nitrate Policies –agricultural aspects for 7 EC countries," *Statens Jordbrugsøkonomiske Institut Rapport nr 77*, 1994.

⁵ Our assumptions are: unit cost is BEF 40 to 52 per kg of live weight; 115 kg per finishing hog, \$ 1 = BEF 36.

USDA-FAS. "Attaché Query Detail," various issues.

DENMARK

Environmental Regulations

Denmark has extensive regulations on manure management and spaying practices regarding nitrogen. The perceived truth is that nitrogen is an agricultural problem, whereas phosphate-based pollution originates with the urban sector. Nitrates residues in water and ammonia emissions are the major environmental concern linked to animal production in Denmark. The whole country has been identified as a vulnerable zone for nitrate pollution in the framework of the 1991 EC Nitrate Directive (see below).

The 1987 Aquatic Environmental Action Program set targets for reduction of emissions of nitrogen, phosphate and other organic matter. Another objective was to eliminate runoff from storage of animal manure. In 1990 it was recognized that the objectives in terms of nitrogen leaching reductions were not achieved. The 1991 Action Plan for Sustainable Agricultural Development aimed at reducing nitrate pollution from agriculture.

Hog farms have to be equipped with manure storage facilities, which have to be covered and with a capacity equivalent up to 12 months of waste. Leaching is prohibited and lagoons are not permitted; the storage facility has to be in concrete. Most livestock farms now comply with this storage no-leaching requirement. Large farms have tougher requirements than small farms. Farms with less than 31 livestock units (30 fattening hogs per year = one unit) are required to have storage facilities for at least 6 months and this requirement has been tightened recently, to up to 12 months. The time requirement depends on the liquid state of the waste. The more liquid the waste, the longer is the requirement. Most farmers do comply with this requirement.

There are setback requirements as well. Manure storage facilities must be placed at least 25 meters from private water sources (wells) and 50 meters from communal water abstraction

plants (see Danish Advisory Centre for further details).

Hog farmers can spread manure in concentration which do not exceed 170 kg of nitrogen per hectare-year. This criteria is based on 1.7 unit of livestock and the assumption that a livestock unit produces manure equivalent to 100 kg of nitrogen per year. Spreading schedule is restricted as well. No spreading is allowed in winter for liquid manure, except for winter oilseed rape or wintering grass. For solid manure, no spreading is allowed in autumn, unless a green crop has been planted. The manure has to be incorporated into the land directly (injection).

This criteria of 170 kg of nitrogen per hectare-year is more constraining than the EU criteria of 170 kg of nitrogen per hectare year, because the EU standard is based on residual nitrogen (after absorption by crops). In addition, the EU regulation tolerates exceptions up to 210 kg per hectare, until 1999. Farmers in excess of manure can spread on farmland belonging to mineral-deficit farms. The transfer from surplus to deficit farms has to be documented, but in practice it is hard to monitor.

As in Holland, farmers are required to maintain nutrient balance sheets and fertilizer management plans based on animal waste and fertilizer use. The balances have to be sent to the Danish Ministry of the environment. Animals have preset rates (e.g., fattening pigs are counted as 80 kg of nitrogen for three pigs per year. Fines are levied on farms in excess of nitrogen. This system has been in place since 1994.

Land use requires a cover crop after harvesting to take up nitrogen. 65 percent of the land on each farm has to be covered in winter. There are many qualifying crops (many winter cereals, grass etc). This policy has been in place since 1990. Different crops have different agronomic rates for nitrogen absorption.

New rules are in the making for water pollution induced by nitrates. These new policies

are the results of EU membership and the desire to conform to EU nitrate residue regulation in water (The 1991 EC Nitrate Directive). Despite its stringent policies, Denmark has been experiencing a deterioration of water quality. In the long run, the Danish government is planning to reduce nitrate emissions by 100,000 tons per year, which represent about half of agricultural emissions!. According to the Nitrate Directive, governments of member-states should have defined codes of good agricultural practices by 1993, and should have formulated action programs by the end of 1995 to reduce and address their nitrate problem, with implementation before 1999. Only zones identified as vulnerable by the member-states have to follow these policies. Denmark Germany, Holland and the Flemish region of Belgium are the most vulnerable zones, while other member-states have zone corresponding to a small share of agricultural land. So zoning definition is important.

Large hog operations are being discouraged by recent regulation linking manure and land use for manure disposal (Danish EPA). Farms of 251-500 livestock units per year (1 LU=30 pigs) have to own 75 percent of the land required to spread the manure generated by the operation.⁶ Farms with herds of 15,000 heads per year or larger have to own 100 percent of the land requirement (294 hectares or more). New farms of that scale or larger will not be allowed .

Cost of Regulation

The cost of storage depends on the capacity of facility. The Danish EPA estimate the cost at about DKK 250,000 for a hog farm of about 1800 pigs per year. Under reasonable assumptions this cost translates into about \$2 per hog.⁷ This cost is often subsidized by the government (25 to 40 percent). Hence, the effective cost is within the price range \$1.2 to \$1.5 per hog. The Danish

⁶ The land requirement is 1.7 livestock unit per hectare per year for hogs, i.e., 148 to 294 hectares, of which 75 percent have to be owned by the operator.

government has an elaborate system of subsidies and loans to entice farmers to comply with the regulations (mostly storage). Immediate tax write-offs, improvement grants, environmental grants and guaranteed loans are typically combined.

Another important cost component induced by the regulations is the land requirement imposed on large livestock operation. We could not find readily available estimates for this regulation. There is anecdotal evidence of land price doubling in hog-producing regions. Land is used to grow crops and provide some additional revenues. Hence, the cost increasing effect of the land requirement is not readily determined. The cost of the land requirement increases with the scale of operation. In the case of large hog operations (as large as 15,000 hogs per year), land-ownership requirement would be about 294 hectares. Land price is “traditionally in the vicinity of 100,000 DDK/hectare. The gross cost of the land requirement is around \$14 per pig without accounting for the revenue brought by cultivating the land. This figure is an absolute upper bound on the cost of the land requirement on large hog farms.”⁸

There are moderate penalties for noncompliance with regulations. The typical fine is 5000 DDK for negligence-based violations, but reaches 10,000 DDK for “active” violations (DDK 6.63= US\$ 1). The Danish EPA considers the penalty system as inadequate.

Factors Influencing Competitiveness.

Denmark has stringent domestic policies. It will have fewer problems meeting the European nitrate standards than its competitors in Northern Europe (Holland and the Flemish region of Belgium). However, the policies are costly and will become costlier have environmental

⁷ We assume that the storage tank last 10 years with linear depreciation. Initial cost is 250,000 DKK. The exchange rate is \$1 = DKK 6.63. This yields a figure of \$ 2.09 per hog

⁸ The assumptions are as follows: a 5-percent time preference yields an annual rental value of \$ 754 /hectare; 51 pigs are allowed per hectare.

protection expands. The forthcoming policy prohibiting new large operations will preclude realizing some economies of scale.

Labor cost is much higher in Denmark than it is in the US and Canada -labor cost is about twice as high as in the US. Denmark is not positioned to be globally competitive, but it is competitive in the EU and in some export markets partly because of EU exports subsidies (see below). Some economies of scale could be realized by decreasing the labor cost share and cost per hog could decrease by increasing farm size.

Land prices have been affected by the environmental regulation, especially in regions with intensive livestock industry. Manure/land requirements have induced sharp increases in land prices, because livestock tends to be a more profitable activity than other industries and crowds out alternative land uses. Doubling of land prices have occurred in the most intensive livestock regions of Denmark.

The hog industry is well integrated with the processing and export sectors through a system of cooperatives and large slaughterhouses. Processing cost is high relative to what it is in the US (about twice as high as in the US and about at par with Holland).

Danish producers benefit from Denmark's membership in the EU, which supports its hog producers with internal support schemes, import protection and export subsidies. The internal scheme is essentially an aid to private storage, plus an intervention system, which is almost never used. The trade protection is more significant. Before The UR-WTO agreement, variable levies were used to keep competitors out of the EU. Currently, an average tariff equivalent based on carcass is used (68.7 ECU per 100kg of carcass weight in 1997-8 - ECU 1 = US \$ 1.134 in 1997). The tariff-equivalent has been decreasing over time. In 2000-1 it should reach 53.6 ECU/100kg. Rates per cut vary more dramatically (from 18.8 to 219 ECU/100kg in 1997).

Imports under market access commitments are mostly benefiting Central European countries and they are marginal relative to output . Export subsidies are substantial but have been decreasing and are progressively applied to lower quality cuts, which are less competitive on world markets. In 1997 export refunds were about 150 ECU millions which correspond to an implicit subsidy of 33 ECU/100 kg of pork export or about 18 cents per exported kg of liveweight-equivalent. Danish exporters have done well in Japan, without export subsidies. Within the EU, Danish hog producers benefit of course from the high internal price. Denmark also benefited of phytosanitary problems in Holland and exports of live hogs towards Germany has increased considerably since 1997 (both piglets and finishing hogs). The CAP keep feed prices high and this is a major handicap for hog producers in all EU countries. CAP policies keep feed prices artificially high (feed cost is about 40 percent larger than in the US). Unit cost of production in Denmark is around DKK 900 per 100 kg (\$ 136). The most efficient producers have unit cost around \$121 per 100 kg.

References and Sources of Information

Danish Advisory Centre, Department of Agricultural Law. *Environment '95 Rules Applying to Danish Agriculture*, Aarhus 3d edition, 1993.

Danish Environmental Protection Agency. Ministry of Environment and Energy. "Environmental Administration in Denmark," *Environment News* No.17, 1995.

Danish National Committee for Pig Breeding, Health and Production, Aarhus, Denmark

Fortin, E., and Y. Salaun. "Position concurrentielle em production Porcine: Structure, productivites et couts compares Amerique du Nord-Europe," *Agriculture and Agri-Food Canada*, 1995.

Office of Agricultural Affairs. Embassy of the United States of America in Copenhagen.

Rude, S. and B.S. Frederiksen. "National and EC Nitrate Policies –agricultural aspects for 7 EC countries," *Statens Jordbrugsokonomiske Institut Rapport nr 77*, 1994.

Sommer, S.G., et al. "Nitrogen Management on Danish livestock Farms and the related

legislation,” in *Ingenieries EAT – 1996 Animal Manures in Europe*, PP 23-29.

USDA-FAS. “Attaché Query Detail,” various issues.

HOLLAND

Environmental Regulation

Environmental regulations affecting Dutch livestock are extensive and still evolving. Historically, regulation has been focusing on phosphate emissions, but more recently because of EU regulations; nitrogen-based emissions (ammonia and nitrogen leaching) have been targeted as well. Major regulations affecting the hog industry can be categorized as follows: regulation in terms of phosphate quotas, regulations on waste treatment, storage and spreading, and more recently, direct output controls.

The regulations on phosphate are based on manure production rights (MPR). Phosphate production per farm cannot exceed a level corresponding to manure rights owned by the farm. The manure production quota is determined by the historical production of the farm corresponding to pig herd as recorded in 1987 multiplied by a phosphate standard per animal (e.g., 7.4 kg per fattening pig-year and 20.3 kg per sow-year) MPRs can also be based on available land. Animal-based MPRs are directly offset by land-based MPRs. Rights based on land attached to the farm are worth 125 kg of phosphate per hectare and they are called “ground-linked” MPRs. The government has reduced the historical animal-based MPRs by 30 percent in 1995. Farmers expand their MPRs by increasing land use or by buying MPRs, which are tradable but are taxed by 25 percent at every transaction (a reduction in the MPR by 25 percent at every transaction).

The MPR quotas are tradable between farms within regions, and from manure-surplus regions to manure-deficit regions but not the other way around. Some regions are designated in surplus of phosphate if they exceed an aggregate quota (these regions are the traditional hog and cattle producing regions of Holland). MPR quota prices vary between 20 and 30 gulden per kg of

phosphate (1996 prices) (about US\$ 10 to 15 per kg). Lately, MPR prices have increased dramatically because of high uncertainty on manure policy, but the high prices are considered to be a market bubble by Dutch specialists. Since farmers offset historical MPRs if they expand land-based MPRs (a one-to-one offset), they have incentives not to expand existing hog farms by increasing their land input, but to circumvent this rule by creating new livestock entities based on “ground-linked” MPRs. The MPR coefficients per animal per year are as follow. For sows including piglets up to 25 kilos: 20.3 kg of P₂O₅ hectare; for sows including piglets up to 6 weeks: 14 kg of P₂O₅ hectare; for “weaners” (6 weeks to 25 kg): 2.7 kg of P₂O₅ hectare; for fattening pigs (25 to 110 kg): 7.4 kg of P₂O₅ hectare.

Starting this year (1998) loss standards are introduced both for nitrogen- and phosphate-based emissions. The loss is the supply of nutrient minus nutrient intake per hectare. The following criteria are used: for phosphate, 40 kg per ha; for nitrogen, 300kg/ha. Taxes are levied for amount in excess of these standards. For excess between 40-50 kg of phosphate: Dfl 5 per kg; above 50 kg/Ha the tax is 20 Dfl per kg (Dfl 2.0172 =US\$ 1). The loss standards will be tightened to 20 kg of phosphate and 180 kg of Nitrogen by 2008. Prescribed supply standards in 1998 are 120 kg /Ha of grassland, and 100 kg/ha of arable land. These will be decreased as well to 80 kg/ha by 2008. All farms have to keep nutrient balance sheets for both types of nutrients.

Acceptable practices have been defined for spreading in terms of techniques and time of the year to minimize nitrogen-based emissions (both leaching and ammonia). There are restrictions on the time of application (mostly fall and winter) which vary by soil type and crop. The 1991 EU Nitrate Directive sets a maximum nitrate concentration of 50 PPM in drinking water, and defines residual nitrogen level per hectare, which are consistent with such nitrate concentration 170 kg of nitrogen per hectare per year). Holland violates both standards (nitrate

residues and applications). Meeting the EU nitrate standard will imply lower applications of nitrogen on land than the current applications rates and a reduction in ammonia emissions as well. Ammonia regulations address nitrogen-based emissions. Manure storage facilities are regulated and have to satisfy requirements linked to the size of the herd and have to be covered to reduce volatilization of nitrogen.

Excess manure has to be shipped or treated. In addition, the EU also regulates shipping and exports of slurry. The slurry has to be processed and there are standards set on maximum allowable microorganisms to minimize disease transmission. There is a well-established market for the treatment and shipping of manure, especially in the surplus regions. Hog manure has a negative price in Holland.

Additional ammonia regulation is in place. The regulation varies by location and works with a quota system. Each farm has to satisfy a maximum concentration limit for ammonia, which varies by location. Farms in excess can buy ammonia quota from deficit farms, but within the county. There is a well-established market for these ammonia quotas.

For odor, pig producers need a permit from the local government to have livestock buildings on the farm base on the Nuisance act. The permits stipulate the maximum number of pigs allowed on the farm. The number is based on proximity of neighbors. Since odor and ammonia are highly correlated positively, farmers can increase the number of animals on the farm if they abate and meet a “green label” requirement. The standards for the labels are linked to the facilities used for the production. Currently there are about 20 different technological systems satisfying emissions standards of the green label.

The 1998 regulations are of a new nature because they directly affect the supply of hogs (USDA-FAS). They are severe. Herds on each farm will be decreased by 10 percent this year,

with further decreases planned for coming years, but with at least a 20-percent decrease achieved by the year 2000.

Cost of Regulation

Detailed cost figures are provided in the appendix. The cost of current regulations on MPRs, manure storage coverage and disposal is small. Reduction of nitrogen by feed modification appears to be “low-cost”, but limited in terms of the reduction of emissions (Leneman et al.). Ammonia reduction in pig houses through building modification is costly. Further loss of competitiveness should result in the Dutch agricultural sector from compliance with the EU nitrate directive. Significant reductions of nitrogen-based emissions to satisfy the EU nitrate directive would be costly (see appendix for cost estimates). An elimination of nitrogen emissions could cost up to \$27.88 per hog! Hence, current regulations (storage, MPR, accounting, waste disposal) do not appear prohibitive, but it is likely that drastic reductions in nitrogen-based emissions will compromise the competitiveness of many livestock industries in Holland.

Factors Influencing Competitiveness

The cost of hogs in Holland appears to be principally influenced by traditional cost items, such as feed cost (\$68.8), housing cost (\$20.4), labor costs (\$7.5) (den Houden). Waste disposal is small and estimated at \$3.8 per animal. So is the MPR per hog. The reference unit cost is estimated at 114.4 US 1996\$/finishing hog for a finishing capacity of about 6200 hogs per year (den Houden).

The EU supports its hog producers with internal support schemes, import protection and export subsidies. The internal scheme is essentially an aid to private storage, plus an intervention system, which is almost never used. The trade protection is more significant. Before The UR-WTO agreement, variable levies were used to keep competitors out of the EU. Currently, an

average tariff equivalent based on carcass is used (68.7 ECU per 100kg of carcass weight in 1997-8 - ECU 1 = US \$ 1.134 in 1997). The tariff-equivalent has been decreasing over time. In 2000-1 it should reach 53.6 ECU/100kg. Rates per cut vary more dramatically (from 18.8 to 219 ECU/100kg in 1997). Imports under market access commitments are mostly benefiting Central European countries and they are marginal relative to output. Export subsidies are substantial but have been decreasing and are progressively applied to lower quality cuts, which are less competitive on world markets. In 1997 export refunds were about 150 ECU millions which correspond to an implicit subsidy of 33 ECU/100 kg of pork export or about 18 cents per exported kg of liveweight-equivalent. The CAP keep feed prices high and this is a major handicap for hog producers in all EU countries.

Major phytosanitary problems have recently occurred in the Dutch livestock industry (mad cow disease and swine fever). These problems have decreases herd size in the short run but also have damaged the reputation of the industry both domestically and in export markets. The problems may have originated in the surplus regions, allegedly with new farmers not following regulations and accepted practices for feed.

The hog industry has lost a lot of political support among policy makers which has translated in quotas on animals (a decrease of herds by 20 percent by the year 2000, -10 percent decrease in 1998). It is probable that further herd reductions will occur, given the situation of surplus of nutrient at the national level with respect to EU standards. Potential for expansion of the industry towards export markets seems unrealistic because of the current animal concentration in Holland and the public and political perception of animal waste saturation in Holland. The new output control measures are consistent this conjecture. We also make the conjecture that Dutch producers and policymakers would be in support of leveling the

international playing field of environmental regulations affecting hog production in major hog-producing countries.

Appendix for Holland : Cost of Environmental Regulation (1997 US dollars)

Manure production rights:

MPR (phosphate quota): between \$0.25 and 0.30 per hog (Wossink)

Reduction in nitrogen emissions:

Some minor reductions (3-16 % reduction in emissions) can be achieved through feed at very low/no cost

Manure cover for a 2000-pig year farm (5% reduction in volatilization): \$0.56 per hog (Leneman)

Manure cover (roofs for 70 to 98 percent reduction in emissions): \$0.24 to 1.15 per pig (Burton)

Manure storage with roof for 6000-pig farm: \$0.46 per hog (den Houden)

Air cleaning in pig house (90 percent reduction in volatilization of N): \$5.87 per hog (Leneman)

(65% decrease in nitrogen emissions): \$9.50 per hog (den Houden)

building modification (38.5 reduction in nitrogen volatilization): \$8.47/per hog (den Houden)

Package to decrease 94% of nitrogen volatilization and 82 percent of nitrogen leaching: \$11.46 per hog

70% decrease in nitrogen emission and elimination of P emissions : \$4.52 per hog (den Houden)

Elimination of nitrogen emissions and reduction of P emissions (92%) \$ 27.88 per hog (den Houden)

Industrial manure processing (87.6 reduction of P and 72.6 % reduction of nitrogen leaching):

\$1.94/per hog (den Houden).

Reduction in P emissions:

Some minor reductions (11-24 % reductions) can be achieved through feed composition at low/no cost.

Manure processing before spreading (a 86 % reduction in leaching of P emissions)): about 5.225 \$ per pig (Leneman)

Elimination of P emissions with cost minimization: \$0.57 per hog (den Houden)

Industrial manure processing (87.6 reduction of P and 72.6 % reduction of nitrogen leaching): \$1.94/per hog (den Houden).

Other cost

Manure disposal cost :\$3.8 per hog (den Houden)

References and Sources of Information

Burton, C.H., ed. *Manure Management. Treatment Strategies for Sustainable Agriculture*. Silsoe Research Institute, Wrest Park, UK, 1997.

Den Ouden, M. "Economic modelling of pork production-marketing chains," *Mansholt Studies* No 4, Wageningen Agricultural University, 1997.

Derrick, P.J.L., J.G.L. Hendriks, and P.J.W. ten Have. "Management of livestock manures in the Netherlands –the current situation," in *Ingenieries. EAT. Special Issue 1996. Animal Manures and Environment in Europe*, EU Commission, Directorate General for Agriculture, 1996.

Leneman, H. et al. Costs of Reducing Nitrogen and Phosphorous Emissions on Pig Farms in the Netherlands," *Journal of Environmental Management* 39 (1993): 107-119.

Ministry of Agriculture, Nature Management and Fisheries, The Netherlands. "Policy Document on Manure and Ammonia," 1995.

Rude, S. and B.S. Frederiksen. "National and EC Nitrate Policies –agricultural aspects for 7 EC countries," *Statens Jordbrugsokonomiske Institut Rapport nr 77*, 1994.

USDA FAS. "Fas online, Attaché Query Detail 4/22/98.

Wossink, A. Personal communication, April 1998.

Wossink, A. "A Comparison of Agro-chemical Reduction Policies in the Netherlands and the EU," Mimeo, December 1994, Raleigh NC and Wageningen, The Netherlands.

Vukina T., and A. Wossink “Evolving Environmental Policies and Asset Values: Nutrient Trading Schemes in The Netherlands.” Presentation at the World Congress of Environmental and Resource Economists, Venice, June 25-27, 1998.

POLAND

Environmental Regulation

At this time, the Polish hog industry does not appear to be effectively regulated for its environmental impact. This statement is based on extensive review of USDA-FAS material, contacts with the agricultural attaché at the US Embassy in Warsaw, and a review of information material in English provided by the Polish Ministry of Environmental Protection, Natural resources and Forestry.

Poland has acute environmental problems, but they do not originate in agriculture. The problems are caused by lack of infrastructure to treat wastewater from industries and municipalities, and by improper handling of hazardous industrial waste (OECD, RRI). As a result, water quality is a major concern because it is already poor. 66 percent of water wells exhibit unacceptable nitrate residues (above the 50 PPM level) (Poland Ministry of Environmental Protection Natural Resources and Forestry). However, the link between water quality and livestock waste is current tenuous in Poland, and it is not scrutinized at this time.

If Poland integrates the EU as projected, and then it will have to eventually comply with EU regulations. The EU has explicitly acknowledged more flexible enforcement of environmental regulations for future members, such as Poland to account for their lower income levels. The 1991 EC Nitrate Directive limits fertilizer and manure applications to 170 kg of residual nitrogen equivalent per hectare year. Currently, Poland's applications of fertilizers and manure tend to be below this EU maximum allowable residual (MAR) nitrogen. This EU limit, which is a major binding constraint for many North-European countries, should not be a consideration in Poland in the immediate future.

Factors Influencing Competitiveness

The Polish hog industry has been stabilizing after a harsh economic transition, which decreased herd size. Cost per 100 kg of liveweight is about US\$ 125, which is still not competitive because animals are fat and heavy. It is expected that unit cost per 100 kg could eventually decrease to \$99 with improvements in feed conversion and with cheaper grains. This \$99-unit cost is a reference level, because it is the perceived competitive level for the EU and FSU markets.

Poland has a long tradition in pig breeding and trade; it has the third largest herd in Europe after Russia and Germany. However, the animals are heavy and fat and of heterogeneous quality (van Fernij et al.). Poland has some experience exporting live animals and pork towards Russia (pork), Croatia, The Netherlands and Bosnia-Herzegovina (hogs). However, domestic consumption remains about 95 percent of production and trade is small and distorted.

There are quotas (tariff rate quota) on imports. The pork tariff rate quota is 30 percent on the imports within the quota and 60 percent over the quota. These rates will fall with WTO commitments. In addition, Poland has preferential treatment from the EU (Council regulation 3066/95). For hogs, the tariff quota to the EU is 20 percent of the full EU tariffs. By joining the EU, Poland would receive a net subsidy of 4.5 ECU 10⁹ if it entered the cap (6 billions – 1.5 contribution). In addition, Poland has some variable levies to protect pork producers (USDC). Pork quota import was set to 60,660 tons for 1997 above 1996 levels (31,640). Finally, Poland has decreased its tariffs with CEFTA countries (all tariffs are equalized across countries).

Poland's hog industry is dominated by small farms and former state farms, which are often in disarray. Slaughtering is often done on the farm, and 13 percent of the pork produced is auto-consumed on the farm. Land redistribution for the former state farms has been slow. More than 90 percent of farms have less than 15 hectares (1994). Privatization of the slaughtering

facilities attached to the farms has been very slow as well.

Current processing appears inefficient. There are many slaughterhouses of various capacities and animals are not uniform. Transportation is still expensive in Eastern Europe. Feed availability used to be a problem in Poland in the 1980 and had limited the production of pigs. Imported feed prices remain distorted. Due to large domestic demand for pork in Poland, the derived demand for hogs is traditionally high and the price received by farmers allowed them to make profit. (1991-1995). In 1996 however, prices for pigs relative to feed prices fell below profitable levels (Rowinski).

In sum, the hog industry in Poland has some potential to become internationally competitive in the long run. In the short run, hog producers are handicapped by unrealized economies of scale, lack of integration/coordination with the processing sector, heterogeneous and inferior genetic stock and distorted feed prices (van Fernij et al.). Finally, these producers currently enjoy protection from foreign competition, and current environmental regulation does not appear to affect their competitiveness.

References and Sources of Information

OECD. Environmental Performance Review of Poland, Paris, OECD Publications 1995.

Resource Renewal Institute. *Environment Atlas. Poland*. (Internet Document) San Francisco, 1995.

Rowinski, J. Pig Production and Marketing in Poland. – A Market in Transition, mimeo, Institute of Agricultural Economics and Food Economy, Warsaw, Poland, undated.

United Kingdom Meat and Livestock Commission. “Poland Country Fact Files,” December 1996.

USDA FAS. “FAS on Line. Attaché Query Report,” various issues.

US Department of Commerce. Document 1390, National Trade Data Bank and Economic Bulletin Board.

Van Fernij, J.P., H. Marouby and M. Rieu. Pologne, Republique Tcheque et Hongrie. La Production Porcine dans la Transition Economique. Institut Technique du Porc-OFIVAL, Toulouse, Decembre 1994.

TAIWAN

Environmental Regulation

Taiwan has one major body of environmental regulation affecting the livestock industry, the 1991 National Water Pollution Control Act Amendments, which sets emissions standards for livestock operations. The standards are becoming tighter over time (1993 standards and new 1998 standards being adopted). The new prevailing emissions standards are 80 ppm for biological oxygen demand (BOD), 250 ppm for chemical oxygen demand (COD) and 150 ppm for Suspended solids (SS). All farms with herd over 20 heads have to adopt these standards. Formerly, only farms with herds of over 200 heads had to comply with these standards. The implementation of the new standard for COD can be postponed for two years (till 12/31/99), contingent on an approved plan to upgrade waste water control. These three measures are conventional measures of water pollution concentration). A new regulation requires farms of over 200 heads to build a treatment facility for wastewater. About 80 percent of the latter farms satisfy the 1993 standards (400 ppm for COD, 100 ppm for BOD and 200 ppm for SS) (Council of Agriculture). Since 1997, pressures to regulate the livestock industry have been mounting, because of increasing concerns for water quality. A noticeable positive link between animal production and water pollution was allegedly observed during the recent outbreak of foot-and-mouth disease in Taiwan, which resulted in a 4-million head drop in the Taiwanese pig herd and a consequent sharp decrease in pollution of some watersheds. New zoning regulations are emerging to limit the number of hog farms in the watershed of rivers used for drinking water (USDA-FAS).

Manure cannot be spread on land. Anyway, lagoons are not economical in Taiwan because land is scarce. Typically, treatment separates water and solid waste, which is transported

to central composting sites to be converted in organic fertilizer.

Cost of Environmental Regulation

The environmental cost related to waster treatment decreases with farm size as expected. The range is NT\$ 383 to 149 NT\$ at 1996 prices per pig (US\$ 1 = NT\$ 27.5 in 1996); it corresponds to farms of less than a thousand heads and farms of five to ten thousands heads, respectively. The average fixed cost of building a typical treatment facility is between 1696 and 318 NT\$ per pig.⁹ In terms of cost shares, the waste-treatment figures correspond to 6.71 percent of the unit total cost (per pig) for the smallest farm category, and 3.00 percent for the largest farms.¹⁰ These costs figures are lower bound estimates, because they do not reflect the labor and transportation cost involved in the waste treatment (additional labor involved by treatment versus simple disposal, and transport of solid waste). The latter cost figures are marginal, when compared to the cost of feed (about 60 percent of the cost of hog production).

Factors Affecting Competitiveness

In 1997, Taiwan was plagued by a major outbreak of foot-and-mouth disease, which first resulted in a drastic reduction (4 millions) in its pig herd in March 1997 (USDA-FAS). A smaller outbreak occurred at the end of 1997 and beginning of 1998. A significant loss of reputation for “quality/safety” resulted and a large inventory was reported beginning of 1998, which reflects the loss of quality reputation and lower demand. Taiwanese consumers shifted to beef products, and exports of pork, which were going mostly to Japan collapsed. Taiwanese pork products may be barred from entering Japan for up to 5 years (USDA-FAS).

⁹ The typical technology is called TPWT technology, which is a system including solid separation, anaerobic fermentation and activated sludge treatment.

¹⁰ The assumptions used to derive these cost share figures are as follows: total unit cost per 100 kg is NT\$ 4600 per 100kg and 108 kg of weight per head. The cost figures are 1993 figures inflated to 1996 using price index data from The Central Bank of China.

Taiwan is land scarce and densely populated. These two factors, combined, adversely influence the competitiveness of hog producers. Waste management is much more costly in the latter context, and the population density amplifies the health incidence of pollution and the benefits of abating the pollution.

By contrast, there is a competitive advantage arising from a long traditional of hog production and processing tailored to the Asian market, as well as the geographic proximity of export markets (Japan is the principal market). Another possible improvement may come from liberalized feed prices once Taiwan decreases its trade barriers on feed imports after joining the WTO.

Income has been rising dramatically in Taiwan and its environmental transition is in the making. It is reasonable to expect rising environmental concerns and opposition to the hog industry, and as a result, more stringent environmental regulation. New water quality standards based on nitrate residues will be eventually introduced and nutrient surpluses will be constrained. We predict that environmental costs and production capacity will become a major concern in Taiwan, as it is today in Northern Europe and that the competitive advantage of Taiwanese hog producers will be compromised as it is the case today in Holland. The natural-resource constraint (land-population-water) will become too overwhelming in Taiwan to expect further export expansion in the longer run.

We also make the conjecture that in the short run, industry interests would resist attempts to upgrade and harmonize environmental standards at the international level. The latter would raise the environmental component of the cost of production.

References and Information Sources

Taiwan Livestock Research Institute. "Research and Counselling on Livestock Waste Treatment" On line document March 1998.

Republic of China, Taiwan District. Council of Agriculture. Internet document, May 1998.

----- The Central Bank of China. *Financial Statistics*. December 1997.

Su, Jung-Jeng. Personal communication from the Taiwan Pig Research Institute, March 1998.

USDA FAS "FAS on Line. Attache Query Detail," various issues.