



LEOPOLD CENTER

## Determining the benefits of environmental improvements in pork production and their sustainability: a community-based study of Iowa's pork industry

**Abstract:** *What is a sustainable environment worth to pork producers, neighbors, rural community residents, and pork consumers? Surveys and experimental auctions were used to gauge participants' willingness to pay for pork products produced in systems with differing environmental improvements and/or impacts.*

**Principal Investigator:**  
James B. Kliebenstein  
Economics

**Co-investigator:**  
Sean P. Hurley  
Economics  
Iowa State University

**Budget:**  
\$32,458 for year one  
\$29,636 for year two

### Background

Swine production is a major economic activity in Iowa with approximately 94,000 jobs directly related to pork production. In a typical year, swine gross receipts represent 30 percent of all agricultural marketing in the state. Meanwhile, the U.S. pork industry has been undergoing a major structural change. In the past, the industry relied on the “community” farmer located in the region known as the Corn Belt with an average inventory between 500 and 999 head. In recent years the pork industry has seen a rapid expansion of large production operations with inventories that exceed 1,000 head. These operations use state-of-the-art production facilities in an attempt to mass produce pigs in a cost-efficient manner.

The move to larger production facilities has had three major effects in Iowa:

- Squeezing out the small pork producers who do not have the capital to expand their operations and adopt new technologies,
- Increasing potential hazards such as manure spills and odors in Iowa's environment, and
- Regaining same cost competitiveness for the Iowa hog industry.

Environmental issues related to livestock production—particularly pork production—have received increased attention in recent years. Threats to surface and groundwater quality as

well as livestock odors have been cause for concern, along with manure spills that have had a significant environmental impact in Iowa and North Carolina. Large-scale hog operations associated with the spills have become the focus of attention for a worried public. The swine industry's ability to effectively handle environmental issues within a sustainable framework will be key to maintaining its competitive position.

While livestock production is linked with these environmental ailments, little is known about how society views the value or benefit of reductions in these problems. This project attempted to determine the value of environmental improvements in pork production. Consumers from Iowa, Kansas, Vermont, Oregon, and North Carolina were asked to place a value on benefits from reduced odor and runoff or manure spills. Participants included pork producers, their neighbors, rural community residents, and urban residents living in locations ranging from those with a large hog production base to those living long distances from pork production facilities.

Surveys and experimental economics (Vickery auctions) were used to elicit participant responses and willingness to pay for environmental and economic sustainability and/or improvement of air, surface, and groundwater quality affected by pork production. The expected outcome of this research was the iden-

tification of consumers' willingness to pay a premium for pork produced with environmentally friendly attributes, or attributes beyond mere eating quality. This would help determine if there were possible rewards or niche market potential for pork producers who employ environmentally friendly systems.

Two primary and two secondary objectives existed for the project. The primary objectives were to determine:

- Consumer, producer, and community benefits or values placed on environmental improvements in pig production, and
- Differences, if any, that exist by consumer location on willingness to pay for environmental improvements, and on a potential for niche markets that reflect environmental attributes embodied in the pig production process.

The secondary objectives were to determine:

- The economic sustainability of environmental improvements in pig production by gauging if it is more cost effective for consumers and producers to deal with cleanup costs from environmental mishaps, rather than paying a premium for environmental fixes or prevention strategies, and
- Economic and environmental impacts of community-based pork production operations.

## **Approach and methods**

Pork producers, their neighbors, agribusiness personnel, and others in adjacent rural communities, along with pork consumers located in urban areas removed from pork production operations were surveyed and participated in the experimental auctions. The first portion of the project gathered information that helped shape questions in the survey and assisted in the experiment design. The second part conducted experiments and surveys for data collection. Data was analyzed in the final stage.

Information on different pork production methods and what effects they have on the environment was collected from researchers in animal science and agricultural engineering, as well as from the National Pork Producers Council and the Iowa Pork Producers Association. Environmental attributes, such as level and potential for air and water degradation, were determined for each system. Two environmental impact levels (low and high) were determined. Potential odor reduction levels were either 30-40 percent (low) or 80-90 percent (high). Surface and groundwater impact reductions were either 15-20 percent (low) or 40-50 percent (high).

Experiments were conducted in six U.S. cities: Ames, Iowa; Iowa Falls, Iowa; Manhattan, Kansas; Raleigh, North Carolina; Burlington, Vermont; and Corvallis, Oregon. A random sample of individuals from the area being studied was used to obtain participants for the study.

Two surveys were conducted during each experimental session. The first occurred before the auction and included personal data and information on industry issues. The second survey after the auction dealt with specific knowledge about pork production, with questions pertaining to methods of obtaining environmental attributes in products.

The auction method used was a second-price, sealed-bid auction divided into five bidding rounds. Products up for bids were two-lb packages of uniformly cut, boneless, 1-1/4 inch pork loin chops. The participants were allowed to bid simultaneously on 10 different packages of pork chops, each having different environmental attributes.

In the first three rounds the participants bid only on the physical attributes of the product having no other information except for previous round's bids. This allowed participants to become familiar with the auction and obtain feedback on price information.

<b>Experiment Area</b>	<b>Number of Participants</b>	<b>Number of Premium Buyers</b>	<b>Number of Non-Premium Payers</b>	<b>Percent Premium Payers</b>
All areas	329	204	125	62
Ames, IA	49	30	19	61
Manhattan, KS	60	40	20	67
Raleigh, NC (6/28/97)	31	19	12	61
Burlington, VT	27	15	12	56
Iowa Falls, IA	58	35	23	60
Corvallis, OR	60	38	22	63
Raleigh, NC (6/27/98)	44	27	17	61

Table 1: Number of Participants by Area

After the third round of each experiment, each participant was told that one package was a “typical package” with no assigned environmental attributes. In this same round, the other nine packages were assigned various levels of environmental attributes relating to groundwater, surface water, and odor. Odor reduction was at low (34-40 percent) or high (80-90) levels, while surface and groundwater impacts were reduced at low (15-25 percent) or high (45-50) levels. Products were provided with a single attribute (only air, surface, or groundwater), double attributes, or three attributes. The double and triple attribute pork products were all placed at the high reduction levels.

In the fourth round, the participants were informed of the specific environmental attributes associated with the respective products. In the fifth round, the implications of the environmental attributes were further explained and participants were allowed to bid a final time.

## Results and discussion

Premium payers were considered as those who increased their bid from the no information round to the information round. Using this definition, approximately 62 percent of the 329 participants increased their bid for the most environmental good, i.e., that product with all three attributes-air, surface, and groundwater safety.

For the entire group, the average premium paid for the most environmentally attractive two-lb package of pork loin chops was 94 cents, while the “typical” package decreased by 52 cents. Bids in the round where no information was released are much closer together than bids in rounds where the participants were made aware of the environmental attributes. The difference between the high and low bids in the “no information” round was

only 35 cents, reflecting the participant perception of the visual quality of the packages. Bids in the no information round were scattered randomly among the packages. Once environmental information was released to the bidders, the more environmental pork packages received higher bids and the less environmental packages garnered lower bids. The triple attribute package commanded the highest premium.

Evaluation of results for the premium payers shows that the average premium was \$1.60 for the most environmentally sound package, a premium of 37 percent. Nonpremium payers for the same package decreased their bids by 15 cents. Both the premium payers and the nonpremium payers decreased their bids for the typical package when environmental information was provided.

For the most part, there were no significant differences in premium payments between regions. The percentage figure of participants willing to pay a premium also did not change dramatically between regions. For example, 62 percent of all participants paid a premium for the triple environmental product. This ranged from 56 percent of the Burlington, Vermont, participants to 67 percent of the Manhattan, Kansas, participants.

As the number of environmental attributes increased, the portion of the population offering increased bids also went up. A higher percentage of the participants were willing to pay a premium for the triple environmental attribute than the double attribute product which, in turn, was higher than for the single attribute product.

*Participant characteristics* Of the participants, about 6 in 10 were female, reflecting the fact that the primary home food purchaser was invited to take part in the experiment. Females also were more likely to pay a premium for

environmental enhancements. The average age of participants was 48 years with 2.69 individuals per household. Most consumed meat, poultry, and fish.

Participants indicated that they read labels on the products they purchase. About one-half indicated that they had noticed environmental attributes on labels and 95 percent would like to have environmental information on product labels. Nearly all (93 to 96 percent) said that they would buy a meat product that had environmental qualities specified on the label.

Environmental awareness on the part of the producer was valued by the participants. Roughly equal amounts of each group (84 to 93 percent) indicated that it was important that the pork they consumed was produced by a farm operator who was educated about the environment and ecologically sound production practices. Industry programs focusing on environmental education are important and are looked upon favorably by consumers.

In surveys about issues of concern and importance, participants were generally very to somewhat concerned about the environment, water quality, air quality, food prices, and pollution. The level of concern was generally lower for family farming, production methods, animal welfare, confinement livestock systems, and changing farm structure. Premium payers showed higher concern for air quality, food prices, family farms, pollution, livestock confinement systems, and changing farm structure.

*Views on environmental improvement methods* Participants were surveyed on the acceptability of methods used by producers to control livestock odors. Filtration of air from livestock buildings was an acceptable method for odor reduction while adding microbial and enzyme additives to manure had a lower level of acceptability. Chemical additives to manure was an even less acceptable choice. Like-

wise, use of chemicals in a hog's diet as a means of odor control was not acceptable to participants, while use of natural additives was highly acceptable.

When asked about odor control, participants indicated that manure storage and injection methods were a matter of concern. Participants were more accepting of manure storage systems that were above ground and away from the pigs. The highest level of acceptance (43 percent) favored composting with bedding material.

Worth noting is that about one-fourth of the participants were neutral about the methods of manure storage and incorporation used by the producer. Another 10 to 20 percent had no opinion on these matters. Education may be needed because this indicated a number of people who are neutral or have no opinion about manure management.

There also was a large number of participants who were neutral (22 to 23 percent) or had no opinion (12 to 16 percent) on manure injection and storage methods as they perceive these practices to be related to groundwater conditions. Half (50 percent) indicated that manure storage above ground in steel/cement structures was acceptable, while 37 percent found below ground storage adequate.

Eighty-two percent of the participants are concerned about the impact of livestock production on the environment and eight in 10 are concerned about the worker environment. Nearly 50 percent are concerned about the changing farm industrial structure.

Almost half of the participants said they were somewhat to not favorable toward total confinement production; 13 percent indicated favorable feelings. Fifty-six percent said pasture production was favorable. Nearly two-thirds (65 percent) had no opinion on the pork production method that uses hoop structures;

they said they were not familiar with this practice.

## Conclusions

Of the 329 participants in this experiment, 62 percent paid a premium for the product with all three environmental attributes: air, surface, and groundwater. For the entire group, the average premium paid for the most environmentally attractive two-lb package of pork loin chops was 94 cents, a 22 percent increase.

Products with multiple environmental attributes commanded a higher price than the single attribute products. For the participants who paid a premium, double attribute products increased from 12 to 16 percent, while the triple attribute product increased by 37 percent (\$1.60).

Bid premiums did not differ significantly among regions. Moreover, the percent of participants paying selected premium levels did not vary among regions. When evaluating the percentage of participants willing to pay by bid level, the distribution shifted to higher bid levels as the number of environmental attributes increased.

Participants had differing attitudes about methods available to reduce odor in pork production. The level of acceptability was highest for filtration of air from buildings and lowest for chemical additives to the animals' diets. Composting with bedding material as a means of odor reduction was the most acceptable manure storage and handling method, while manure storage under the hog building was the least acceptable.

Participants indicated a level of concern for environmental impacts and livestock production. About half (46 percent) were very concerned, while 36 percent were somewhat concerned. In addition, most said they were con-

cerned with the worker and animal environments. Roughly one-half stated that they were somewhat (30 percent) to very (24 percent) concerned about farm structure. Total environmentally controlled livestock confinement was viewed as somewhat unfavorable to not favorable by about half of the respondents.

### **Impact of results**

Results show that consumers are willing to pay for pork products with embedded environmental characteristics. About six in ten consumers said they would pay a premium for this type of product. Further studies should be done at the purchase point in stores with actual products featuring the environmental attributes to see if consumers carry out their intentions as expressed in the experiments.

The project suggests that there is a market for products produced under improved environmentally friendly conditions. Consumers who are concerned about the environment are willing to pay more for products with reduced environmental impacts. Participants encourage producers to use environmental labels on their products.

Some of the participants' perceptions about production methods cited in the surveys are not in line with scientific findings. This points to a need for the industry to increase its educational efforts regarding production practices and associated environment.

### **Education and outreach**

A paper on "Market Potential for Environmental Improvements in Livestock Production—Who Will Pay?" was presented at the Animal Production Systems and the Environment Conference in Des Moines in July 1998. A poster session on "Consumer Willingness to Pay for Meat Products with Differing Environmental Attributes" appeared at the American Association of Agricultural Economics 1998 Annual Meeting. Results have been shared with an Iowa Pork Producers Association task force and via an ICN program. A Ph.D. dissertation is being completed on the project findings and highlights will appear in other publications.

*For more information  
contact James B.  
Kliebenstein, Economics,  
Iowa State University,  
Ames, Iowa 50011;  
(515) 294-7111; e-mail  
jklieben@iastate.edu.*