



## FIELD TESTING OF ODOR REDUCTION TECHNOLOGIES ON SWINE OPERATIONS PROGRESS REPORT

### Introduction

Urban-rural conflict over large-scale animal agriculture has become commonplace during the past several years. In particular, odors from large swine operations have caused neighbors to complain that they can not enjoy their homes and lives. However, commercial swine producers are reluctant to invest in technology that is often expensive and unproven.

The following study was undertaken, with support from the College of Agricultural Sciences at Penn State, and grants from the Pennsylvania Department of Agriculture. In addition, cooperating farms and companies also contributed time and equipment to these projects.

### Objectives

1. Determine the effectiveness and manageability of three odor reducing strategies on selected swine operations in Pennsylvania.
2. Determine physical and personal factors affecting odors scores recorded by neighbors of swine farms.
3. Determine how neighbors and nonneighbors of swine farms perceive large livestock operations.

### Procedures

In the summer of 1999, researchers at Penn State, with financial support from the Pennsylvania Department of Agriculture, sought to include neighbors in evaluating three economical strategies for reducing odor complaints from hog farms.

Odors on hog farms arise from three sources: land application of manure, manure storage, and air exhausted from the buildings. In this study, researchers attempted to control odors from either air or outside manure storage structures, but not odors associated with spreading manure.

Three odor control techniques were evaluated: biofiltration of exhausted air, dust filtration of exhausted air, and floating biofilters (chopped straw) for outdoor manure storage structures.

Farms for the project were selected based on the practicality of applying the technologies at the specific site, a history of odor conflict in the neighborhood, and operator's willingness to cooperate with the researchers.

### Biofiltration Farms

Two 2,000 and one 4,000-pig finishing operation were selected to evaluate biofiltration of exhausted air. Each pit fan (which discharges gases from the under-building manure storage) on all buildings was fitted with a biofilter. Additionally, two of the buildings were equipped with a larger biofilter to capture some of the exhausted air from end wall fans that ventilate the living space

for the pigs.

Biofilters were constructed of a layer of wooden pallets lying on the ground covered by a layer of plastic mesh and an eight to 12-inch-deep mixture of finished compost and wood chips. Air exhausted from the building was forced under the pallets and allowed to filter through the compost and wood chip mixture. Bacteria in the compost mixture capture and break down odor-causing compounds. Biofilters require about 80 square feet per 1,000 cubic feet per minute of air moved through the building, so this technology was limited to smaller operations because of physical space requirements.

### Dust Filtration Farms

Three fairly large operations were selected for implementing dust filtration technology: one 2,800-sow farrow-to-feeder pig farm, one 1,400 farrow-to-feeder pig farm, and one 10,000-pig finishing site.

On these farms, plastic mesh (shade cloth used in the greenhouse industry) was fashioned into a "windsock" and placed over each fan shroud. It was hoped that the windsocks would cause odor-carrying dust particles to settle more rapidly. Additionally, the socks could potentially disrupt the exhaust stream and help odors to dilute more quickly.

### Floating Biofilter Farms

One 300-sow farrow-to-feeder and one 450-sow farrow-to-finish operations were selected for the third technology a floating biofilter of chopped straw for outside manure storage structures. A commercial landscape seeder was hired to apply an eight-inch covering of chopped straw over the open, outdoor manure storage structures on each farm. Odors escaping from the manure storage structures are filtered by the layer of straw in the same manner as that of biofilters connected to exhaust fans.

### Evaluation

To evaluate the success of each of the odor reduction technologies, all neighbors within a variable radius (generally less than one mile) of seven of the farms were contacted by mail prior to commencement of the project. Each neighbor received a survey about their perceptions of animal agriculture and other information. In addition, each household received six odor evaluation cards one card to be used each week for a six-week period. The survey included a map of the area and neighbors were asked to mark the location of their homes on the map and return the surveys immediately. The odor evaluation cards were to be filled out each day between the hours of 6 p.m. and midnight. Odor was evaluated on a scale of zero (no odor) to five (intense odor). One of the farms with a straw cover was located near a heavily traveled road, but had few close neighbors. Employees of a local business who regularly traveled the road were contacted to evaluate odor from

that site during their drive to and from work.

Approximately midway through the six-week evaluation period, the odor control technologies were installed so odor scores could be compared before and after technology application. Producers at all farm sites were asked to refrain from spreading manure during the period of the study so neighbors would not confuse spreading odors with odors emanating from the site.

During the same time frame, nonneighbors who lived in similar rural settings, but not near large livestock facilities, were identified. These individuals were asked to complete surveys similar to those sent to the neighbors, but without the odor evaluation cards.

### Results

Data are still being tabulated, but we can report the following preliminary findings.

### Demographic Information

With exception of gender, neighbors and nonneighbors were demographically similar. The neighbors who completed surveys were fairly evenly split between males and females, whereas nonneighbors who completed surveys were predominantly male.

### Effectiveness Of Odor Reduction Technologies

Odor scores, in general, were lower than anticipated on the farms. On a scale of zero (no odor) to five (very intense odor), the mean odor score recorded by respondents who returned odor evaluation cards was .85.

For two of the three farms where biofiltration was used, the average odor score declined after installation of the biofilters, and, in one of these cases, the decrease was statistically significant (P less than .05). In addition, although the number of neighbors responding to the farms on which floating biofilters were used was very small, the overall average showed a decline in odor level after the application of this strategy.

Moreover, when standing near the source, our personal observation was that both biofilters and the biocovers were effective in reducing odor levels. As a result, follow-up studies using both of these technologies are planned. The dust filtration "socks" appeared to be ineffective.

### Physical And Personal Factors Affecting Odor Scores

The neighbors' location (both distance and direction from the swine unit) impacted the intensity of reported odor. In general, neighbors closer to the swine facility recorded higher scores than those more distant. Neighbors to the east and south recorded higher scores than those living to the west and north. There were also numerous personal factors that affected perceived odor intensity, including:

1. Whether the neighbor knew the operation/manager of the swine facility or not was related to the reported odor level. In general, the more the neighbor was acquainted with the swine producer, the lower the odor scores.

2. Odor ratings were higher if the neighbor could see the swine facility from the road or home than if they were not visible.

3. The more "attractive" the farm was perceived to be, the lower the odor scores. Attractiveness of the farm in question

if the farm was perceived as more attractive, lower odor scores were recorded.

4. As reported health rating increased, the lower were the odor scores.

With the factors described above, we could account for about 33 percent of the variation in average odor scores.

There were also a number of personal factors that had little or no impact on odor scores. These included income, gender, age, education, whether the neighbor had been raised on a farm, length of time the neighbor had lived there, and the neighbor's reported knowledge of swine production.

Many neighbors commented on their odor diary cards that the intensity of odor during the study was lower than normal because the swine producer was not spreading manure. We asked all the cooperating producers to postpone manure spreading until after the project so that we could evaluate the impact of the building and/or storages alone. While the comments on manure spreading were unexpected, they do reinforce the concept that land application of manure may generate more odor complaints than the buildings or manure storage facilities.

### Neighbor Vs.

#### Nonneighbor Perceptions

Neighbors and nonneighbors were asked to "agree" or "disagree" with a series of 19 statements dealing with their perceptions of large-scale livestock operations. Of those who responded, the answers of neighbors differed significantly from those of nonneighbors for just five of the items. Neighbors were more likely than nonneighbors to indicate that livestock odors represent a health hazard to people living nearby (47 percent vs. 25 percent); to report that odor from large-scale livestock operations are more offensive than other odors associated with farming (59 percent vs. 40 percent); to disagree that large-scale livestock operations provide the same economic advantage to an area as other industries (68 percent vs. 51 percent); to report that livestock farmers should alter their farming practices to satisfy the desires of nearby residents (74 percent vs. 60 percent); and to believe that large-scale livestock operations reduce the value of nearby residential property (77 percent vs. 64 percent).

For the remaining 14 items, neighbors and nonneighbors did not differ significantly in their pattern of responses. Thus, for example, just over 60 percent of both neighbors and nonneighbors agreed that large-scale livestock operations use environmentally sound practices to prevent water pollution. Nevertheless, nearly the same percentage reported that they believed that animal wastes from large-scale livestock operations pollute nearby surface and ground water (65 percent), pollute local water supplies (63 percent), and that governmental controls and site inspections do not eliminate the likelihood that such operations will pollute local water supplies (61 percent).

Two-thirds (67 percent) believed that large-scale livestock always produce odors that are obnoxious to people living nearby and that people living in the country should expect livestock odors as part of country living (78 percent). However, 64 percent reported that they did not agree that livestock farmers should have the right to farm without local restriction, and 66

percent believed that large-scale livestock operations should not be permitted near residential areas. More than three-fourths of both neighbors and nonneighbors agreed that spreading manure from large-scale livestock operations on farmland will enhance the quality of the soil and only about one in five believe that the application of large amounts of manure from intensive livestock operations contaminate the soil, making it useless for other agricultural purposes. Thus, while there were some striking differences between neighbors and nonneighbors in the perception of large-scale livestock operations, there were also quite a number of areas of agreement.

When respondents were asked to rate their overall health status, the scores of neighbors and nonneighbors were identical (4.1 on a scale of 1 not very healthy to 5 very healthy). But when asked about specific medical symptoms, neighbors indicated they experienced cough, nausea, fatigue, and throat irritation more often (P less than .05) than nonneighbors. There were no significant differences between the two groups in regard to frequency of headaches, muscular aches, chest tightness, depression, or anxiety.

The challenge aspect of these observations is that the health score and symptoms are self-rated and therefore may be subject to some bias, particularly if the neighbors regard the local swine operation as a source of conflict. To provide further analysis of the health symptoms, we calculated correlation coefficients between distance from the farm, and health score and all health symptoms. For health score and eight of the nine symptoms, there was no significant relationship (P greater than .20) between the frequency of symptom and the distance from the operation. One correlation (muscular aches) approached significance (P less than .075). If the cause of the symptoms were the facility, then one would expect neighbors living close to the farm would have observed the symptoms more frequently than those living further away, but this was not the case.

To provide further insight into the health symptom observations, we calculated correlation coefficients between the neighbors' reported desire not to live in this location, and the same health symptoms. In this analysis, the frequency of nausea, headache, muscular aches, chest tightness, fatigue, throat irritation, depression and anxiety were all positively correlated (P less than .01) with the neighbors' desire to live somewhere else because of the swine facility. Similarly, health score was negatively correlated (P less than .05). Therefore, it appears that the neighbors' health scores and reported frequency of health symptoms may be related to dissatisfaction with their location, rather than to distance from the swine operation.

A sizable majority of the neighbors indicated that the large-scale swine operation located nearby impacted on their lifestyles in various ways. A third (33 percent) reported that they had often modified their outdoor plans because of odor from the facility, 18 percent had often decided to not invite friend in because of the odor, six percent thought that the odor from the facility often made them ill, and 22 percent reported that they often wished that they didn't live in their current location because of the presence of the swine facility. About 85 per-