

# **Animal Agriculture in South Carolina: A Fact Book**

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# Introduction

*Hal Harris*

In 1996 the South Carolina General Assembly debated and passed the so-called “Hog Bill.” The debate generated a great deal of heat and very little light. Events in North Carolina, not South Carolina, appeared to tilt public opinion toward passage of the bill. The Department of Health and Environmental Control has now incorporated the law into its regulatory framework. The new regulations went into effect in June 1998.

The controversy over animal agriculture continues. In response, a team of Clemson University scientists conceived a project to study economic and social forces affecting animal agriculture in the Palmetto State. This project was funded under the 1997 General Assembly Agricultural Productivity and Profitability initiative.

The specific purposes of the project were:

- 1) to improve the knowledge base of both interest groups and the general public about animal agriculture issues;
- 2) to ascertain South Carolinians’ attitudes and opinions about animal agriculture; and
- 3) to create the environment for an improved dialogue between the industry, concerned citizens, and government on animal agriculture.

This *Fact Book* is the culmination of the team’s work.

## Concerns and Tradeoffs

Formulating public policy involves tradeoffs and compromises among affected citizens. The animal agriculture issue involves a particularly broad array of socioeconomic, health, and environmental concerns (Figure 1). The evidence used in arguments about these issues is often anecdotal, at best. For some issues, peoples’ perceptions may be as important as the facts. A major purpose of this study was to ascertain the importance of some of these issues to South Carolinians based on a random survey as reported in a later section. Another purpose is to provide factual documentation for some of the concerns raised by proponents and opponents of animal agriculture.

**Figure 1. Concerns/Tradeoffs**

◆ Engine of Economic Growth	◆ Environmental Quality, Health Questions
◆ Viability of Ag Without Subsidies	◆ Nuisances
◆ Replacement for Tobacco	◆ Job Quality
◆ Consumers Benefit	◆ Big is Bad
◆ Property Rights	◆ Role of Government
	◆ Who Controls the Sector

## Trends in Animal Agriculture

While there are considerable differences in current trends within the hog, beef cattle, dairy, and poultry sectors, there are a number of common directions (Figure 2). Farms and processing operations are becoming fewer, much larger, and increasingly specialized. Vertical coordination through contract or ownership through the system is increasing. The industry is relocating from historic production regions. There are more confinement operations. Farms tend to “cluster” in relatively small geographic areas. Each of these trends raises contentious issues.



**Figure 2. Trends in Animal Agriculture**

- ◆ Growing Scale of Operations
- ◆ Increasing Specialization
- ◆ Increasing Vertical Coordination
- ◆ Spatial Relocation
- ◆ More Confinement Operations
- ◆ Clustering

### *Growing Scale of Operations*

Just a few years ago, a dairy operation with 200 cows would have been large by national average standards. Today, herds of 1,000 cows or larger are the norm for areas rapidly expanding in milk production such as California, Idaho, and New Mexico. Half the nation’s milk supply now comes from herds of over 200 cows.

Large animal operations mean greater concentrations of waste at a particular site, attracting more public scrutiny. Bigness per se is an issue. Much of the furor over animal agriculture is fed by particular farm interests. Allied with environmental groups, their main concern is that large farms (terms used in the press include megafarms, factory farms, corporate farms) are driving “family” farms out of business. Indeed, today’s large animal operations rely on hired rather than family labor.

### *Increasing Specialization*

Historically, meat and animal product producers raised crops and fed those crops to animals as a value added marketing strategy. Size was limited by acreage of cropland. Today, they tend to produce just meat, milk, or eggs. Crop-raising is often done only as a means of nutrient (manure) disposal. Raising of replacement animals is another production stage that is commonly being spun off. Hog production seems to be moving to a three tier system of production, with large specialized units handling farrowing, nursery, and finishing, respectively.

### *Increased Vertical Coordination*

Terms applied to the strengthening links between input supply, production, and marketing phases include vertical integration, agricultural industrialization, and contract farming. The broiler industry has been vertically integrated for over 40 years. Some of the main names associated with the industry include ConAgra, GoldKist, Tysons, and Purdue. Such corporations own and operate feed mills and processing plants. Since they own the chickens and the feed, it can be argued that technically they are the farmers. Broiler producers own the production facilities and, significantly, the manure and any birds that may die during the production process. They are paid a fee, as specified in a contract with the integrator. Usually the contract contains efficiency incentives. The swine industry is now moving toward the broiler model. Some observers note that this trend is not dissimilar to the movement toward franchising in the fast food and other industries. Like the McDonald’s clerk who presses the key with the Big Mac picture, the farmer pushes the buttons according to the integrator’s specifications.

### *Spatial Relocation*

Separation of growing feed and raising animals means that the local availability of feed no longer determines where animals will be produced. Thus, North Carolina, which is not a large grain-growing area, was able to jump from sixth to second in hog production in the past decade. It made a similar jump in turkey production in the previous decade. California passed Wisconsin as the number one dairy state several years ago. Animal agriculture is growing rapidly in such states as Colorado, Idaho, New Mexico, Oklahoma, and Utah. Geographic relocation, among other things, means that millions of people unaccustomed to the sights, sounds, and smells of animal agriculture now face those issues on a daily basis.

## *More Confinement Operations*

Except for the cow-calf sector of the beef industry, animal agriculture today generally means many animals in a relatively small space—often specialized buildings. This production practice increases the concentration of waste at any particular site. For some, this practice raises questions of humane treatment of animals. A surprisingly large percentage of South Carolina residents in our survey (39 percent) agreed with a statement that animal agriculture raises ethical concerns.

### *Clustering*

Not only is animal agriculture relocating among states, within most states production units tend to cluster together. As an example, two-thirds of South Carolina's milk production occurs in just five counties, three of which are contiguous in the upstate, and two that border one another downstate. Proximity to processing plants is a major factor behind this phenomenon. Achieving economies of size in feed manufacturing plants is another consideration. Clustering also insures that the requisite industry infrastructure exists—access to such things as veterinary services, skilled technicians, and a knowledgeable labor force. Clustering means that statewide statistics such as those given in this report can mask the true picture in given localities.

Clustering raises many questions. Should statewide environmental control regulations be adopted because a few counties have large concentrations of animals? Is local control the answer? Clustering also increases the prospects for different avenues for manure disposal, such as municipalities have for sewage.

## **Forces of Change**

Several key factors are driving the dramatic changes in the meat and animal product industries. The most important are technology, changing consumer demand, changes in processing, economies of scale in production, and instability in input and output prices.

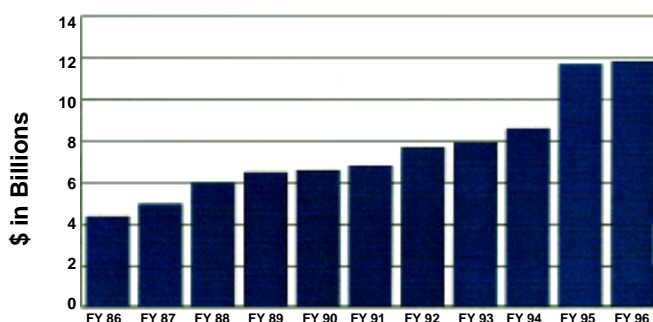
### *Technology*

The animal industries have witnessed amazing growth in productivity in recent years. Since 1988, milk production per cow has jumped 20 percent. The pork and poultry sectors have shown similar gains. Even in the cow-calf sector of the beef industry, which is still characterized mostly by small operations, productivity has doubled in the past 40 years based on the weaning weight of calves. Improved genetics have been a major technological force behind such gains. Not only have improved genetics raised productivity and feed conversion efficiency, they have also resulted in leaner, more uniform animals. Although such technology is not available only to large farms, studies repeatedly demonstrate that large firms have an advantage because they adopt technology earlier than small farms. Note that in the vertically integrated sectors, it is the integrator who controls the genetics and supplies them to producers.

### *Changing Demand for Food*

The restructuring of animal agriculture is in no small measure a response to changing consumer demand. United States consumers are demanding lower fat, easily prepared food. The away-from-home market is becoming increasingly important, now representing 45 percent of food expenditures. In addition, the export market has become a major factor driving growth and change in animal agriculture. United States meat and animal product exports are today highly competitive in the growing world market. Such exports grew from slightly over \$4 billion in FY 1986 to almost \$12 billion in FY 1996 (Figure 3).

**Figure 3. Value of Animal and Animal Product Exports, US - Fiscal Years**



### *Changes in Processing*

The intermediary sector between consumers and producers has undergone even more dramatic structural change than the production sector. For example, in 1996 there were 28 pork processing plants in the United States with annual capacity of 1.5 million head or greater. These plants accounted for 80 percent of total slaughter. In 1982 there were only six such plants, and they accounted for only 17 percent of processing while smaller plants processed the other 83 percent. Now the fewer and much larger plants produce an incredibly diverse product line of specialty items designed for the ready-to-eat and away-from-home market. They demand high quality, uniform animals and products—and are willing to pay premiums or maintain captive supplies to get them. They also prefer prescheduled delivery of truckload lots.

### *Economies of Scale in Production*

Studies repeatedly show that the largest swine, dairy, beef, and poultry operations have lower production costs. The rapid exit of smaller units and growth in number of larger ones provide the ultimate evidence. The U.S. Department of Agriculture (USDA) reported that over 24,000 farmers left the hog industry in 1996 alone. Half of these had an inventory of less than 100. In contrast the number of farms with 2,000 or more head grew by 80 farms.

Studies also indicate that lower cost per unit of production for larger farms includes the cost of waste disposal. The more elaborate the system used to dispose of manure, the greater is the cost disadvantage to smaller farms. Thus, those who seek to save family farms by requiring more stringent environmental regulations face a serious flaw in their logic.

### *Price Instability*

The 1996 Farm Bill freed farmers to produce commodities other than those that previous farm programs had locked them in to producing. Animals, as well as alternative crops, could now be produced. Most economists believe that “Freedom to Farm” will result in more price volatility. Internalizing feed purchase decisions through vertical integration provides a mechanism to cope with such instability, as does the assured regular check provided from a livestock or poultry production contract.

### **Summary**

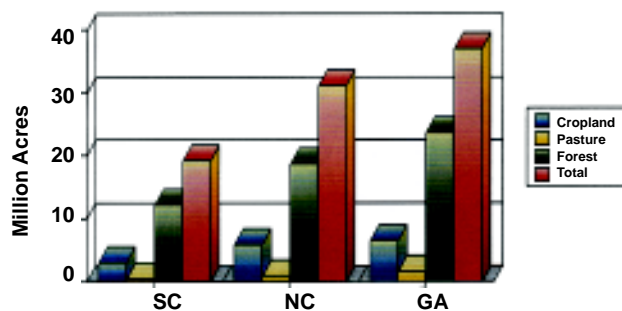
Many citizens have expressed dismay about the changing structure of animal agriculture. Many of their concerns center around the five trends outlined in this section. It is important to note that these forces of change show no signs of abating.

# Current Status of Animal Agriculture in South Carolina: Comparison with Adjacent States

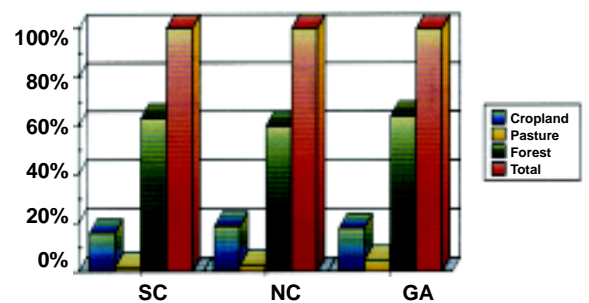
*Hal Harris*

It is hoped that this section will provide agricultural leaders, policymakers, and environmental groups some basis to make informed decisions about the future of animal agriculture in the Palmetto State. Some may question the use of Georgia and North Carolina as a basis of comparison. However, they are our neighbors; their geography and topography are similar to ours. As can be seen from Figure 4, South Carolina's land base is much smaller, but on a percentage basis, land is distributed into cropland, pasture, and forest use in a similar pattern (Figure 5). About one-third of the land in each state is in farms (Figure 6).

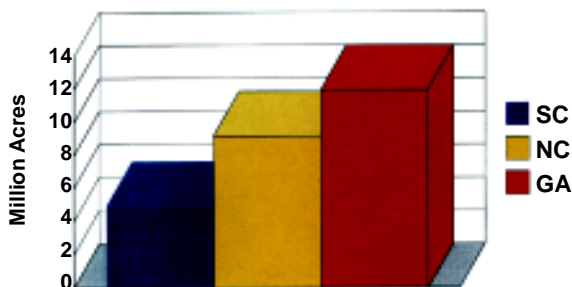
**Figure 4. Land Utilization, SC, NC, GA, 1992**



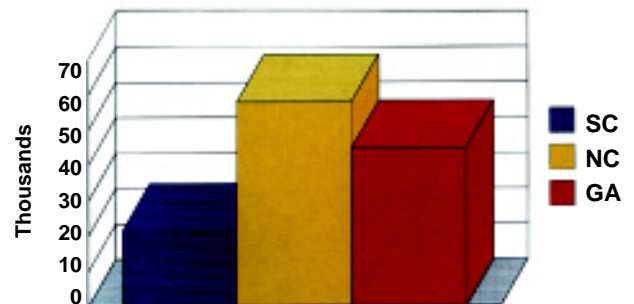
**Figure 5. Land Utilization, SC, NC, GA, 1992**



**Figure 6. Land in Farms, 1996**

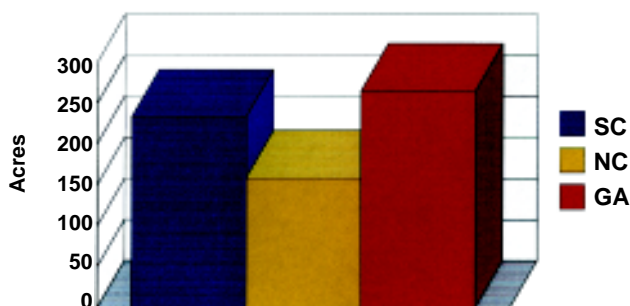


**Figure 7. Number of Farms, 1996**

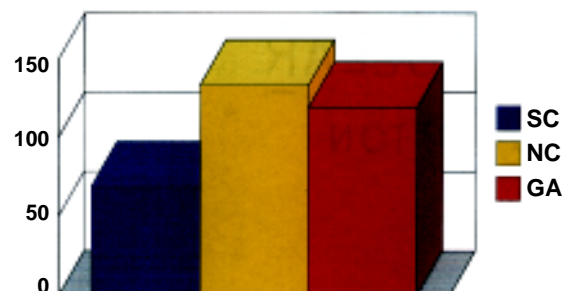


North Carolina has considerably more farms than South Carolina or Georgia, and the average size of farm is quite a bit smaller in terms of acreage (Figures 7 and 8). But in terms of dollar sales per farm, South Carolina lags far behind our two neighbors (Figure 9). A major reason is the growth in animal agriculture in North Carolina and Georgia compared to South Carolina.

**Figure 8. Average Size of Farm, 1996**



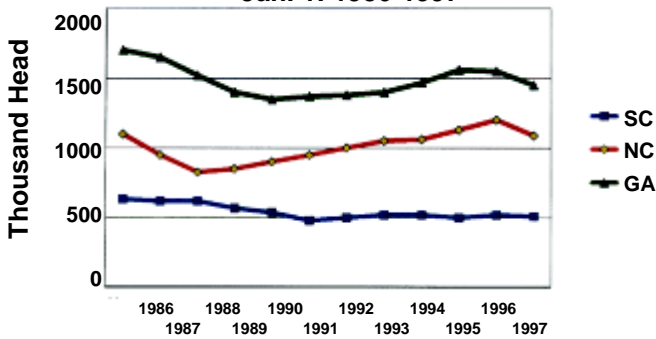
**Figure 9. Sales per Farm, 1996**



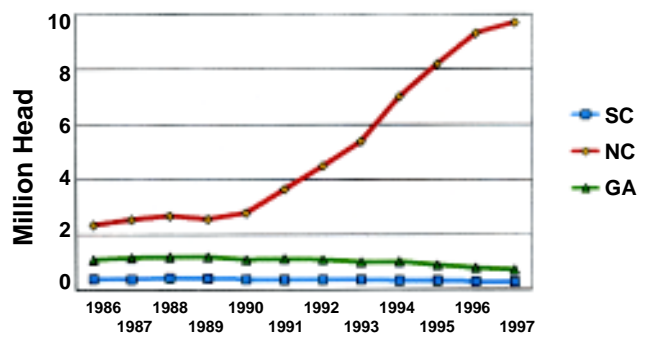
Figures 10 through 14 illustrate trends in animal numbers in the three states during the past 10 years. Key points shown by the figures include:

- Growth in the cattle herd in North Carolina and Georgia during the 1990's, then a falling off with the cattle cycle in the past two years. Declining to steady cattle numbers in South Carolina.
- Dramatic increase in hog production in North Carolina, particularly since 1990. Stagnant to declining numbers of hogs in the other two states.
- Growth in layer numbers in Georgia, declines in the Carolinas.
- Steady growth in broiler production in all three states, but South Carolina production only one-sixth of Georgia's.
- Far greater turkey production in North Carolina than the other two states. South Carolina production up, and greater than in Georgia.

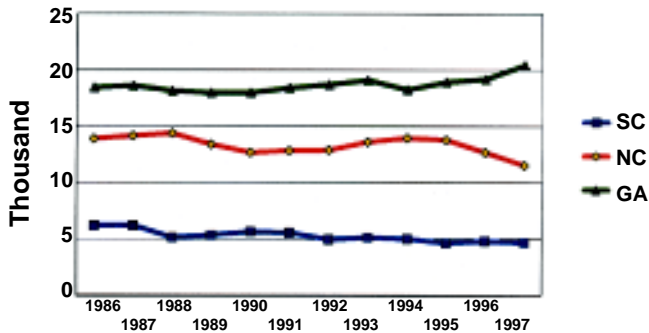
**Figure 10. All Cattle and Calves, Jan. 1: 1986-1997**



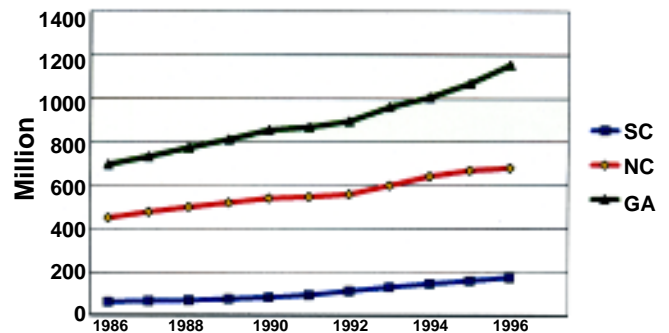
**Figure 11. All Hogs and Pigs Jan 1: 1986-1997**



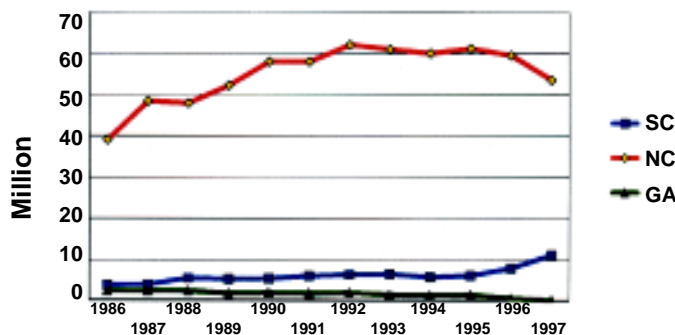
**Figure 12. Hens and Pullets of Laying Age, Jan 1: 1986-1997**



**Figure 13. Broilers Produced, Jan 1: 1986-1997**



**Figure 14. Turkeys Raised, Jan 1: 1986-1997**



The next three illustrations (Figures 15, 16, and 17) show total farm cash receipts, first broken down by crops and livestock, followed by the total of the two. North Carolina's agriculture (in dollar valuation) is now over five times as large as South Carolina's; Georgia's is over three times as large.

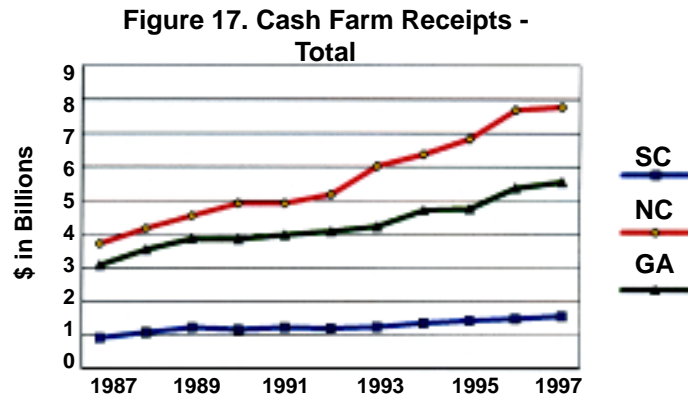
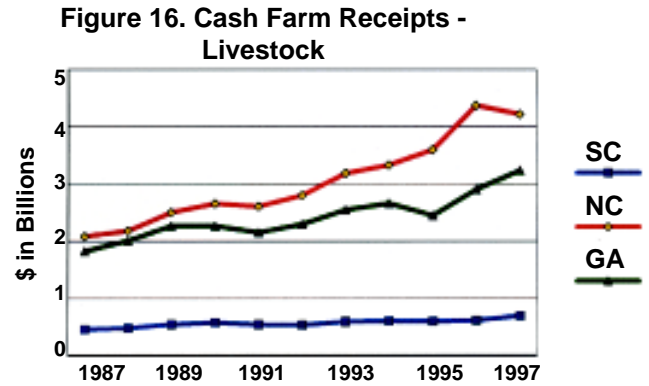
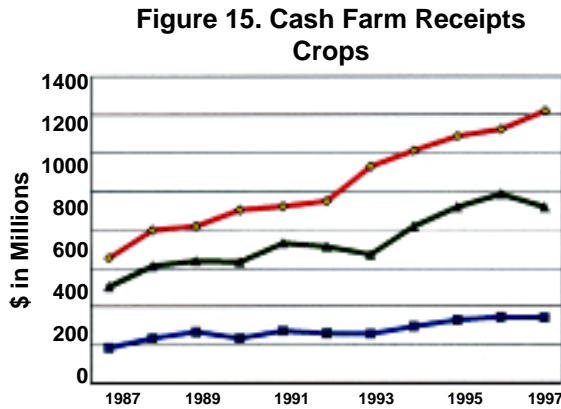
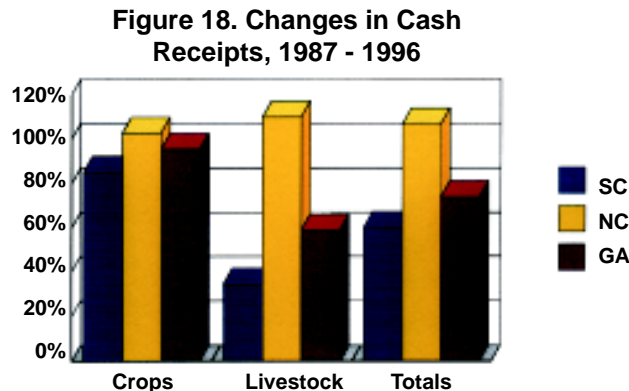
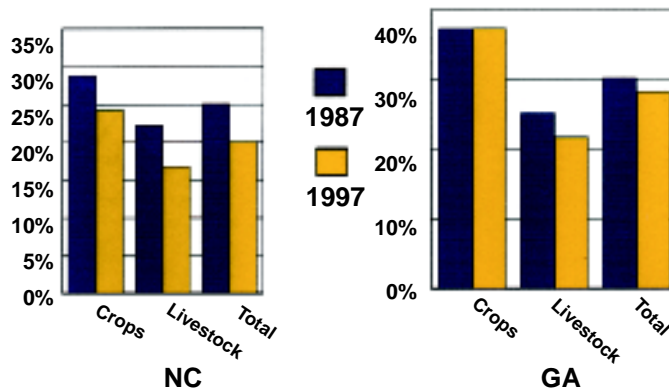


Figure 18 puts these totals in a relative change perspective. While growth in South Carolina's crop cash receipts has almost kept pace with our neighbors, the animal industries did not grow nearly as fast. Income attributable to the poultry and livestock sectors more than doubled in North Carolina from 1987 to 1996. In Georgia the increase was almost 60 percent, about double the growth rate in South Carolina.



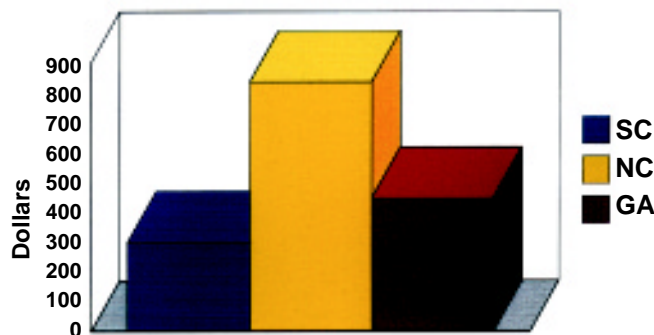
In summary, aggregate farm income in North Carolina and Georgia now dwarfs that in South Carolina, and the widening gap has chiefly been caused by the growth in animal agriculture (Figure 19).

**Figure 19. SC Cash Farm Receipts as a Percentage of NC & GA, 1987 & 1997**



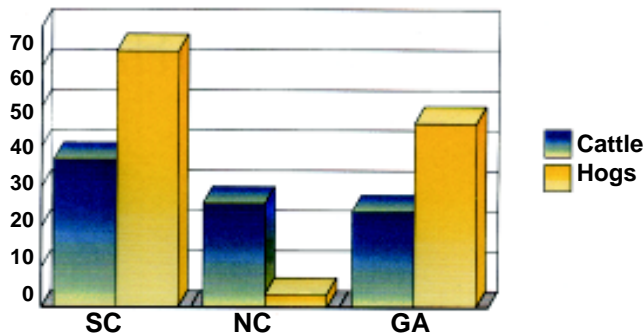
Intensive animal agriculture produces much more income per acre than extensive crop farming. Driven largely by growth in value-added animal agriculture, sales per acre of farmland in 1996 were \$836 in North Carolina, \$448 in Georgia, and only \$299 in South Carolina (Figure 20).

**Figure 20. Sales per Acre of Farmland, 1996**

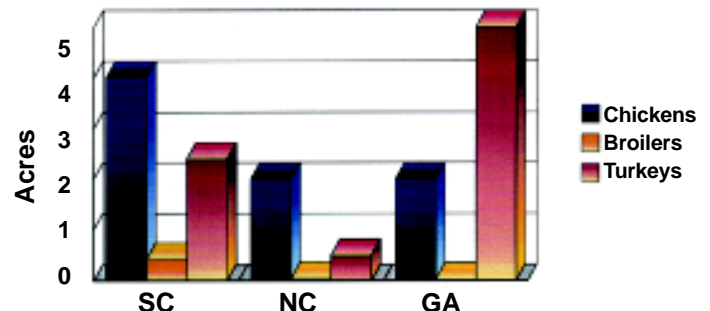


Comparing animal numbers to the three states' total land base provides an aggregate indication of animal concentration. Under the currently used method of manure disposal (land application), acres per animal provides some notion of statewide application rates. The higher the bar on Figures 21 and 22, the greater is the land base per animal. For example, in South Carolina we currently have one pig for each 60+ acres; North Carolina has only about 4 acres for each hog. Only in turkeys per acre does South Carolina surpass either of the other states—and then only Georgia.

**Figure 21. Acres per Animal**



**Figure 22. Acres per Animal**





Figures 23, 24, and 25 provide a final basis of comparison among the states. The more animals there are in comparison to people, the greater it would seem the likelihood of incidents of unpleasant interactions in the form of odors, etc. South Carolina annually produces half as many broilers per capita as North Carolina, one-third as many as Georgia. The most striking comparison is with hogs — in North Carolina each citizen today could adopt a pig! The only case where South Carolina has more animals per capita is in turkeys compared to Georgia. Thus, it is not surprising that animal agriculture concerns registered low on the survey reported in the following section.

Figure 23. Animals Per Capita, 1996

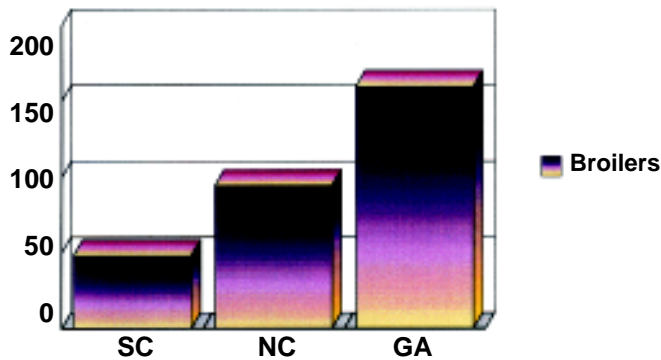


Figure 24. Animals Per Capita, 1996

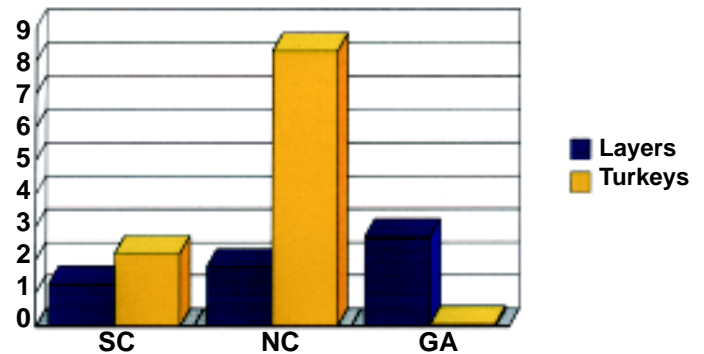
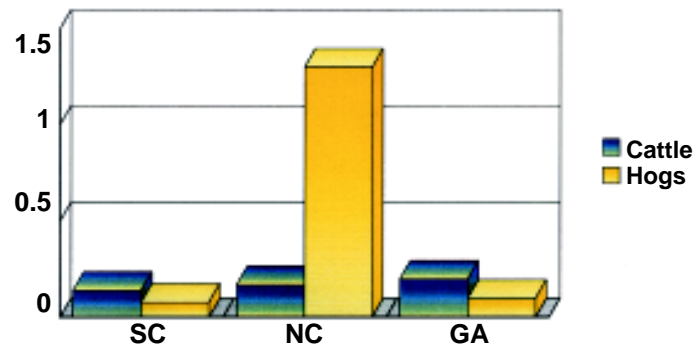


Figure 25. Animals Per Capita, 1996



## Conclusions

The individual reader must form an opinion as to whether we have too few animals on farms in South Carolina, whether there are too many in our neighboring states, or whether animal agriculture in all three states can continue to grow under the right regulatory environment. It is clear from the data shown here that farm income in South Carolina has suffered because of slow growth in animal agriculture. The gap in incomes by any basis—total, per farm, or per acre—is widening compared to our neighboring states. This gap carries over into employment opportunities in the farm supply, feed, processing, and marketing sectors.

There is a long list of tradeoffs involved in public decisions about the growth of animal agriculture in our state. The changing structure of the animal industries makes discussions of these tradeoffs even more contentious. But an improved dialogue among affected interest groups needs to occur. It is hoped that the information in this *Fact Book* will be helpful in achieving more enlightened discussion of the issues involved.



# Adult South Carolinians' Opinions about Animal Agriculture

*B. J. Vander Mey, Catherine Mobley, and J. E. Hawdon*

## Executive Summary

A random sample of 700 South Carolina residents was interviewed between December 1997 and February 1998. Interviews were conducted via telephone, using Clemson University's CATI (Computer-Assisted Telephone Interview) laboratory. The foci of the study were opinions about the effect and importance of animal agriculture and support for additional animal agriculture. The error margin for this study is  $\pm 4$  percent.

The survey instrument was predicated upon a review of literature (see references), combined with several meetings of the team members. Requests for a copy of this survey instrument should be addressed to Dr. B. J. Vander Mey.<sup>1</sup>

In general, most respondents were supportive (73 percent) of additional animal agriculture in their counties. They look to animal agriculture to support farmers (especially family farms), to employ others, and to bring in other businesses. They are concerned about the possibility of odors, environmental problems, and flies. The majority (57.7 percent) agreed that tougher environmental regulations for animal agriculture are needed, but 71.6 percent think that people are working to reduce the environmental impacts of animal agriculture. Stronger support for animal agriculture was found among whites, people who have not been bothered by odors, those who think animal agriculture is economically important, and those who agreed with positive statements about animal agriculture and preserving the family farm and negative statements about environmental groups. Few agreed that animal agriculture was a real nuisance because of odor (22.3 percent) or that animal agriculture had reduced their quality of life (12.0 percent). However, 39.9 percent agreed that "animal agriculture raises serious ethical concerns regarding the treatment of animals."

## Sampling Strategy

Given the foci of the survey, South Carolina counties were inversely weighted by population. Then a random selection procedure was followed. In this way, counties that are more rural—those most likely to be home to any additional animal agriculture, were slightly oversampled in this study.

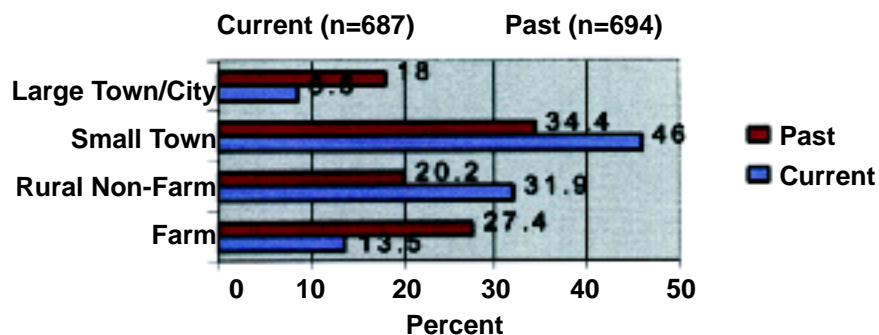
## Counties Represented

The counties with 35 or more respondents in this survey were Allendale, Barnwell, Calhoun, Chester, Darlington, Dillon, Edgefield, Florence, Greenwood, Jasper, Laurens, Lexington, Oconee, and Orangeburg. The counties with less than 35 respondents were Abbeville, Aiken, Beaufort, Cherokee, Clarendon, Fairfield, Hampton, Lee, Pickens, Richland, and Saluda. Thus, respondents represented 25 of the state's 46 counties.

## The Respondents

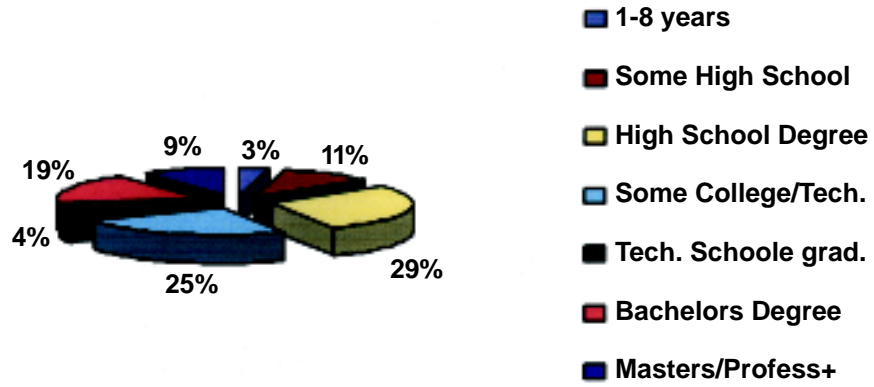
Figures 1 through 4 illustrate some of the main characteristics of the respondents in the sample.

**Figure 1. Current and Past Residence Type of Respondents**



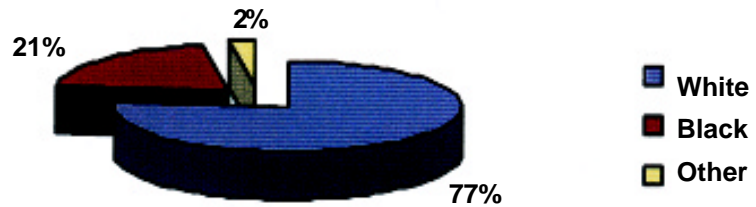
**Figure 2. Educational Attainment of Respondents**

(n=689)



**Figure 3. Race of Respondents**

(n=700)



**Figure 4. Sex of Respondents**

(n=700)



### *Other Characteristics of the Sample*

- 77.1 percent of the respondents were native South Carolinians.
- Age of respondents ranged from 18 to 91, with a mean of 46.42 years.
- The majority of the respondents (63.8 percent) were married at the time of the survey.
- Over three-fourths (77.7 percent) of the respondents had children.
- Mean estimate of how far respondents live from an animal agriculture operation: 4.93 miles.
- Mean estimate of how much of South Carolina's economy is derived from farming: 42.87 percent.
- Slightly under one-fifth of the respondents (17.3 percent) said they were members of at least one<sup>2</sup> farming or environmental group. Of these respondents, membership included
  - Farm Groups: 54.5 percent.
  - Environmental Groups: 20.6 percent.
  - Church or Religious (did not differentiate farm/environmental): 19.8 percent

### *Brief Discussion of the Sample*

As previously indicated, the sample was drawn in order to ensure that the more rural counties were included, given the purposes of the study. As noted in Figure 1, 46 percent of the respondents said that they currently live in a small town, and 8.6 percent indicated that they live in a large town or city. The Census definition of urban population includes "... places of 2,500 outside Urbanized areas." (South Carolina Statistical Abstract '97, p. 319). Thus, some small towns in South Carolina are urban.

If one were to combine the responses "Large Town/City" and "Small Town" into one variable, "Urban," the figure would be 54.6 percent of the sample. If one were to combine the responses for "Farm" and "Rural Nonfarm" in the survey to create the category "Rural," the figure would be 45.4 percent rural. According to the most recent Census report, the population in South Carolina is 54.6 percent urban and 45.4 percent rural (South Carolina Statistical Abstract '97, p 348). This survey accomplished the goal of ensuring representation of the state's more rural counties. Given the error margin of the survey, it is safe to say that both the more rural and the more urban residents were adequately represented in this survey.<sup>3</sup>

That there seemed to be a shift from more urban and farm to more rural nonfarm residences among the respondents cannot be addressed adequately in this study. It is quite possible, however, that the shift is at least a function of the aging of the farm population (retiring, moving to rural nonfarm residences) and the trend toward seeking small towns and rural nonfarm residences among younger and middle-aged people (see, e.g., Dubbink, 1984; Wimberly, 1987; Johnston & Beale, 1994).

That women were slightly oversampled is typical of telephone surveys. Women tend to answer the phones more at home and tend to agree to participate in a survey more than men do. Whites were slightly oversampled in this survey (78.7 percent in this sample versus 69.0 percent in the population). This too is probably a function of whites' greater comfort with telephone surveys.

The educational profile of the respondents closely resembles the educational attainments of adults in South Carolina, with a slight underrepresentation of less educated adults and a slight overrepresentation of more educated adults.<sup>4</sup>

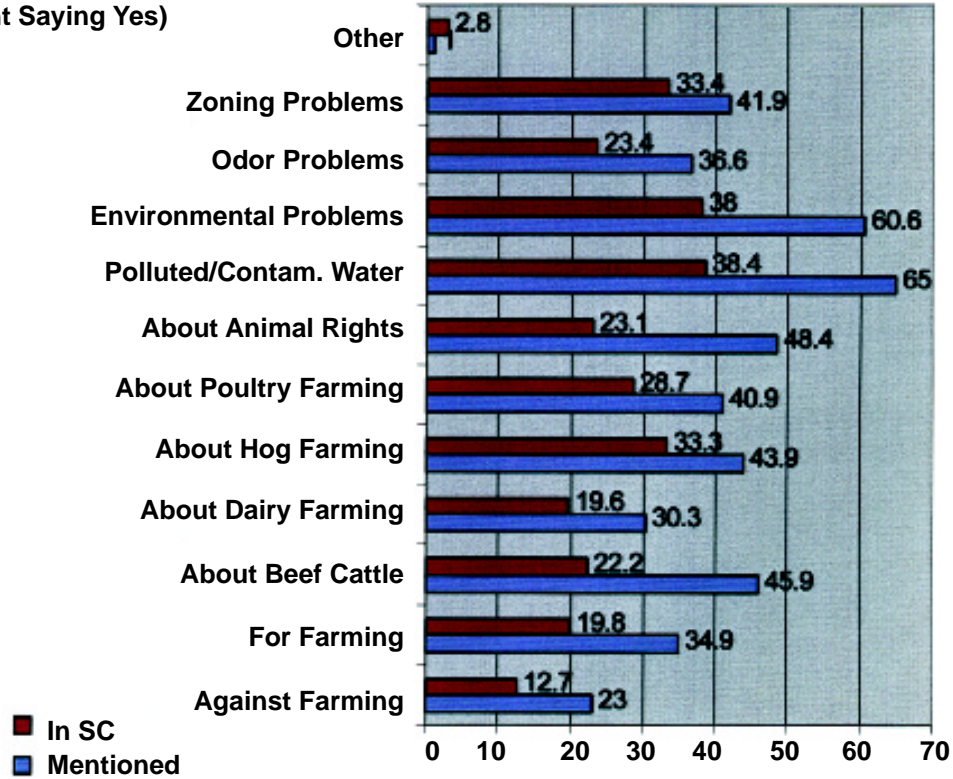
## Findings: General Descriptives

### *Exposure to Media Stories*

Figure 5 shows whether respondents had been recently exposed to stories about agriculture, in other states (“mentioned”) or specifically in South Carolina. Figure 6 shows the primary sources of information about these stories.

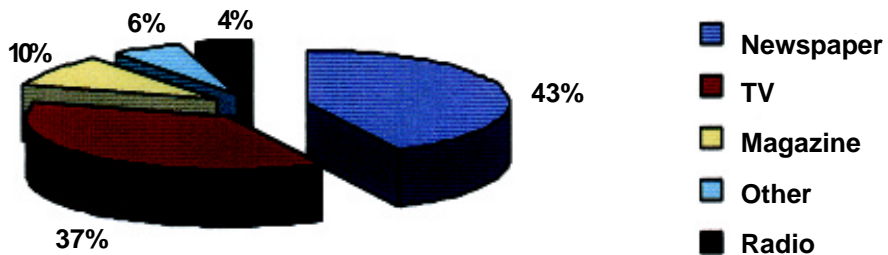
**Figure 5. Recent Exposure to Stories About Farming**

(n=700; Percent Saying Yes)



**Figure 6. Source of Information on Farming Story**

Source of Information on Farming Story (n=616)



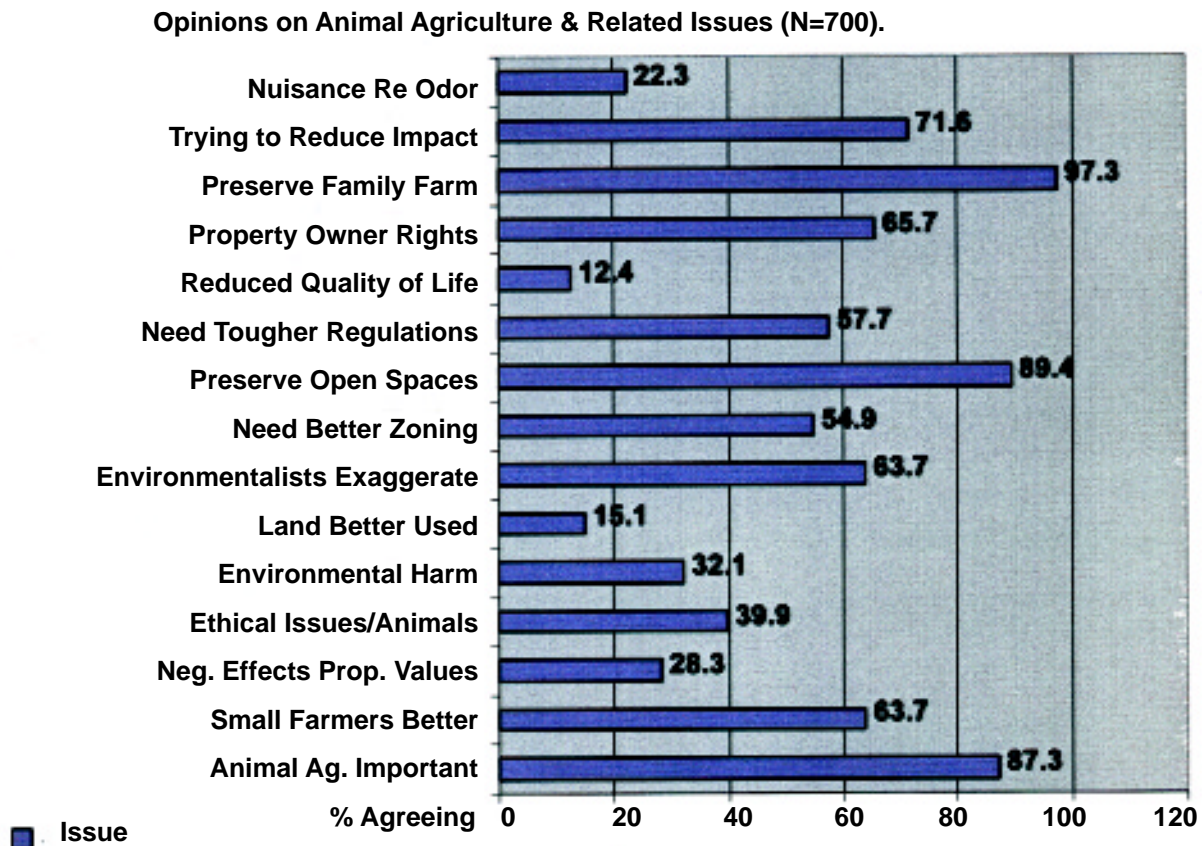
## Opinions About Animal Agriculture

Respondents were asked questions pertaining to animal agriculture (see list below). A chart (Figure 7) depicts the percentage of respondents agreeing with each statement.

Statements read to respondents

- “Animal agriculture is a real nuisance because of the odor.”
- “People involved with animal agriculture are working hard to reduce their operations’ impact on the environment.”
- “It is important to this country that family farms be preserved.”
- “Property owners have the right to do with their property what they wish.”
- “Animal agriculture has reduced the quality of life for me.”
- “We need tougher environmental regulations around animal operations.”
- “The preservation of open spaces is important to me.”
- “We need better zoning to separate animal operations and residential areas.”
- “Environmentalists exaggerate problems associated with animal agriculture.”
- “Land used for animal operations could be used for better purposes, such as residential, manufacturing or business.”
- “Animal agriculture causes environmental harm, for example, water and soil pollution.”
- “Animal agriculture has negative effects on property values.”
- “Small farmers who have livestock do a much better job of protecting the environment than do the large or corporate operators.”
- “Animal agriculture raises serious ethical questions about the treatment of animals.”
- “Animal agriculture is important to the economy in this county.”

**Figure 7. Agreement on Statements About Animal Agriculture**

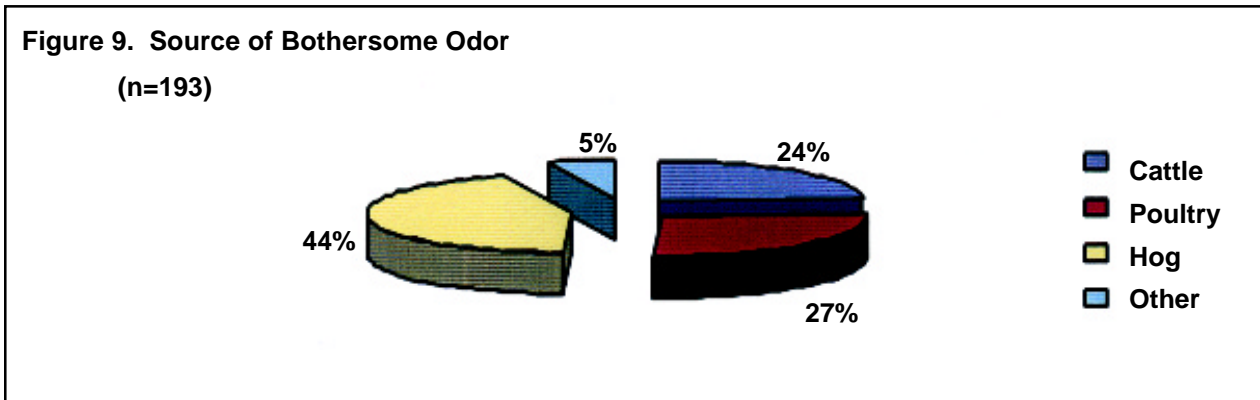
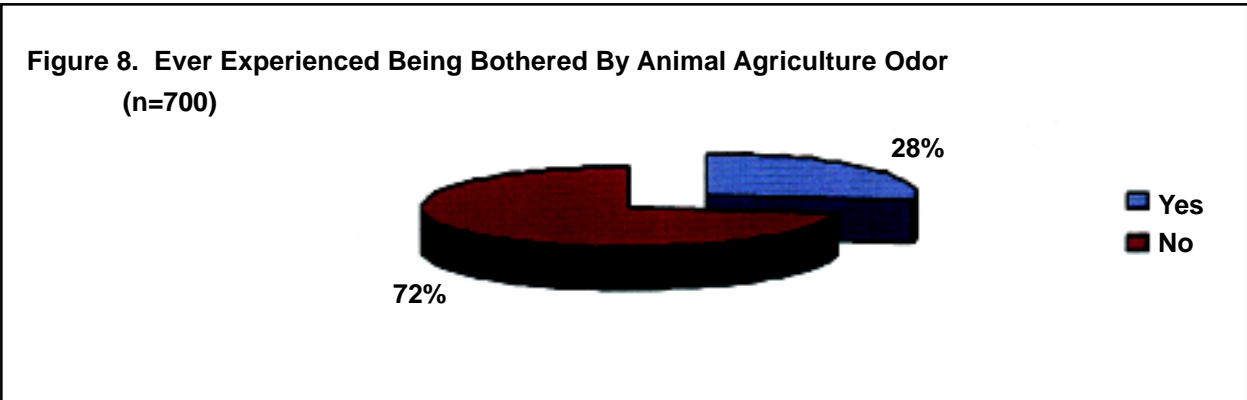


Summary of Opinions About Animal Agriculture:

- Respondents usually tended to Agree or Disagree, rather than say “Don’t Know/No Opinion.”
- Most respondents agreed that: family farm and open space preservation were important and animal agriculture is economically important in their respective counties.
- Well over one-half agreed that: operators are trying to reduce animal agriculture’s environmental impact; environmentalists exaggerate animal agriculture’s impact on the environment; small operators are doing a better job of protecting the environment; property owners have the right to do as they see fit with their property; tougher environmental regulations are needed regarding animal agriculture; and better zoning is needed to separate animal agriculture operations from residential and other activities.
- About one-third of the respondents agreed that animal agriculture causes environmental harm, while only 15.1 percent said the land could be used for better purposes.
- Only 12.4 percent agreed that animal agriculture had reduced their quality of life.
- Over one-third (39.9 percent) of the respondents agreed that animal agriculture raises serious ethical concerns regarding the treatment of animals.

*The Odor Issue*

Respondents were asked if they ever had been bothered by the odor of animal agriculture. Of the 700 respondents, almost three-fourths (72.4 percent) said no (Figure 8). Of those who had been bothered by the odor, 44.0 percent identified the source of the odor as coming from hog operations, 26.9 percent from poultry operations, and 23.8 percent from cattle operations. A few of the respondents (5.2 percent) said the source was “other” (Figure 9).

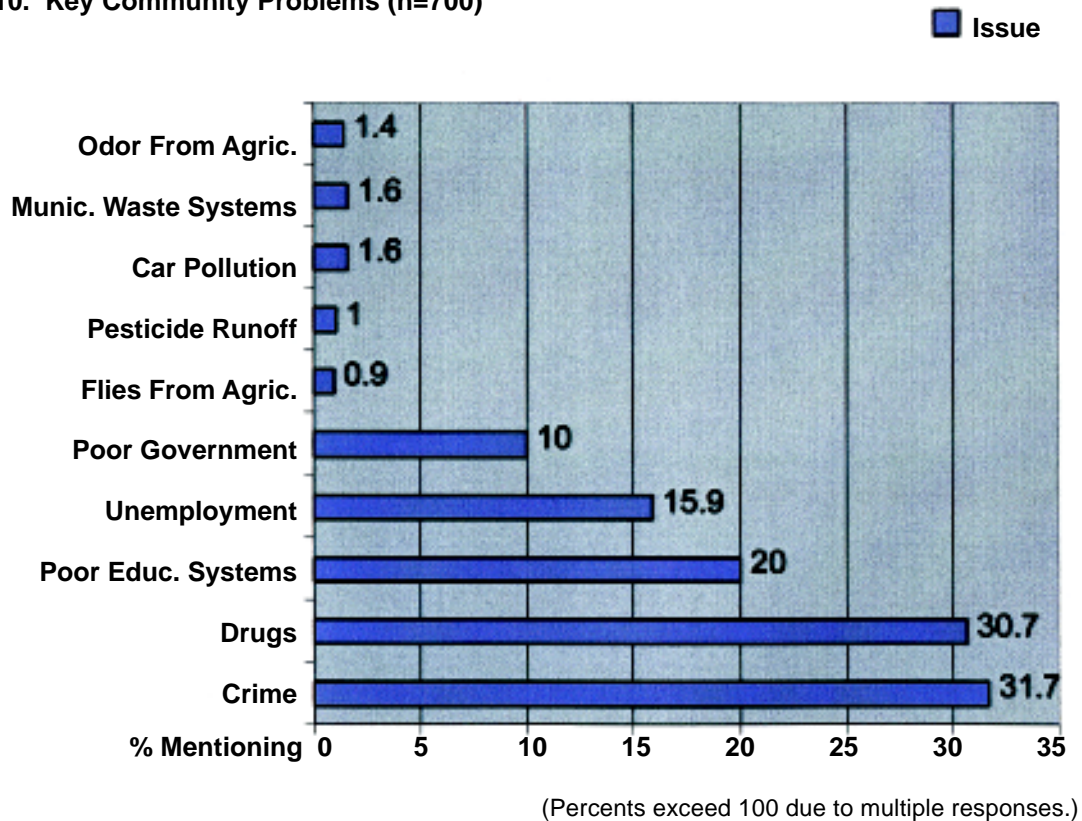




### Key Community Problems

Respondents were asked to identify up to three main problems facing their communities. Figure 10 depicts the five most and least frequently mentioned problems. It should be noted that “other” was anticipated in this survey. Not precoded for the computer but mentioned by some respondents were problems such as dogs running loose, family breakdown, race relations, and water drainage problems. Overall, the respondents seemed very concerned about social problems in their communities. Environmental issues did not appear to be high priorities.

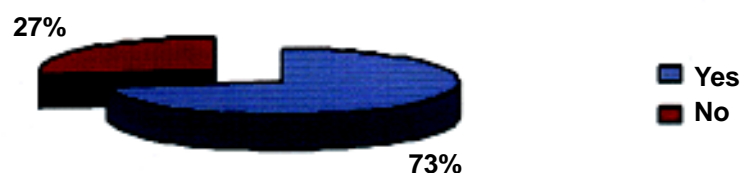
Figure 10. Key Community Problems (n=700)



### Support for Additional Animal Agriculture

Respondents were asked if they would support additional animal agriculture in their respective counties. Nearly three-fourths (73.3 percent) of the respondents said yes (Figure 11).

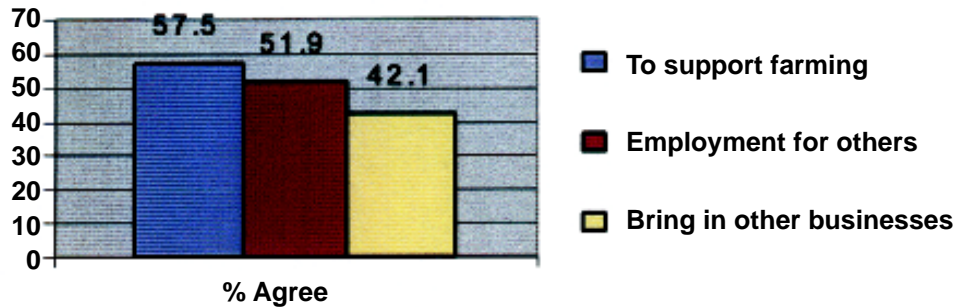
Figure 11. Support for Additional Animal Agriculture (n=700)



Respondents then were asked to explain why they would or would not support additional agriculture. Interviewers coded in the first three responses provided. Of the 513 respondents who said that they would support additional animal agriculture, only 3.1 percent provided no reasons.

- Main reasons for supporting additional animal agriculture (Figure 12) were to support farming, to provide employment for others, and to bring in other businesses.
- More open-ended responses for support included the idea that it's "good for the children," that it "provides food," and "I do not like city life."

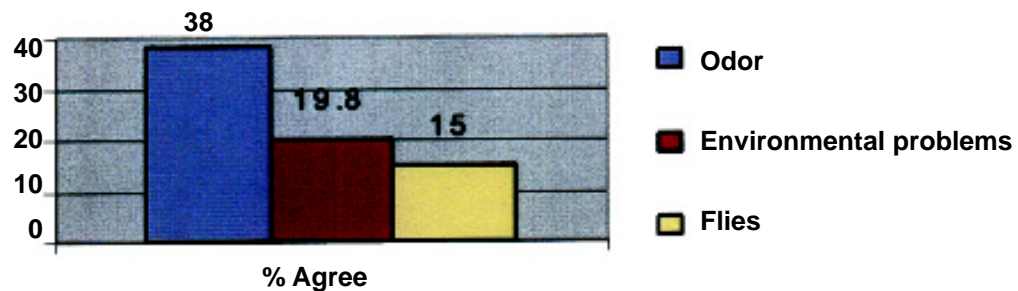
**Figure 12. Reasons to Support More Animal Agriculture (n=513)**



Of those saying they would not support additional animal agriculture, 25.1 percent gave no reason.

- The main reasons for not supporting additional animal agriculture were odor, environmental problems, and flies (Figure 13).

**Figure 13. Reasons for Not Supporting Additional Animal Agriculture (n=187)**



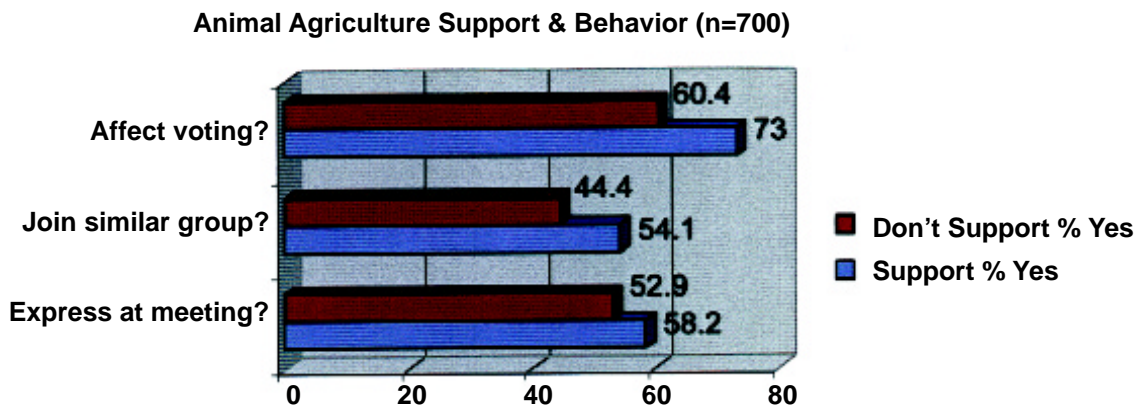
- More open-ended responses included the idea that there already was enough animal agriculture, that the county is too populated, and that the county is too small to support additional animal agriculture.

Respondents then were asked if their decision about supporting or not supporting additional animal agriculture was strong enough that it could affect their voting, whether they would join a group with similar opinions, and whether they would express their opinions at a public meeting. The responses are displayed in Figure 14.

- Those who would support additional animal agriculture are more likely to translate their support into some kind of action.
- Those who would support additional animal agriculture were significantly more likely than those who would not to vote their support, and to join other groups with similar views.



**Figure 14. Support/Non-Support of Animal Agriculture and Behavior**

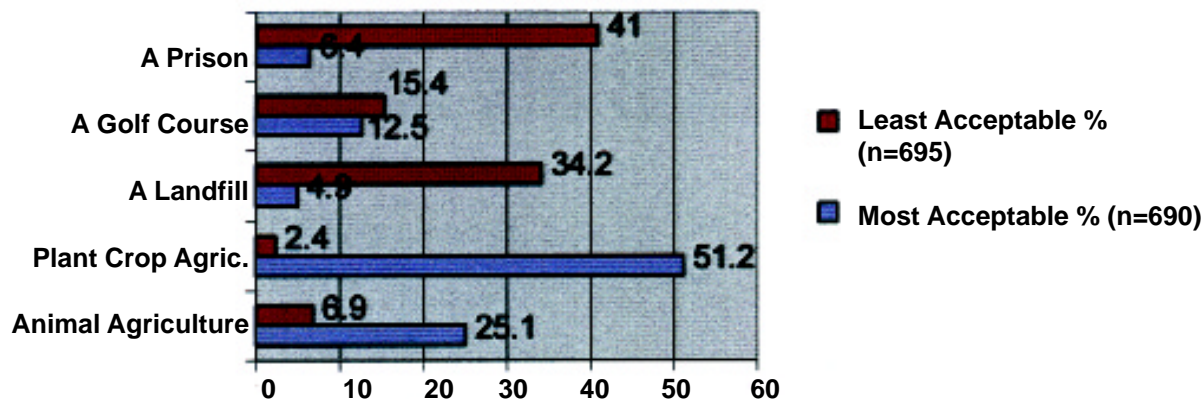


*Most and Least Acceptable New Venture for the County*

Respondents were asked to “vote” for the most and least acceptable new venture for their respective counties. The choices were animal agriculture, plant crop agriculture, a landfill, a golf course, and a prison. The results are depicted in Figure 15 below.

- The respondents selected plant crop agriculture as most acceptable (51.2 percent), with animal agriculture (25.1 percent) coming in second place.
- The least acceptable ventures were a prison (41.0 percent) and a landfill (34.2 percent).

**Figure 15. The Most and Least Acceptable New Ventures for the County**

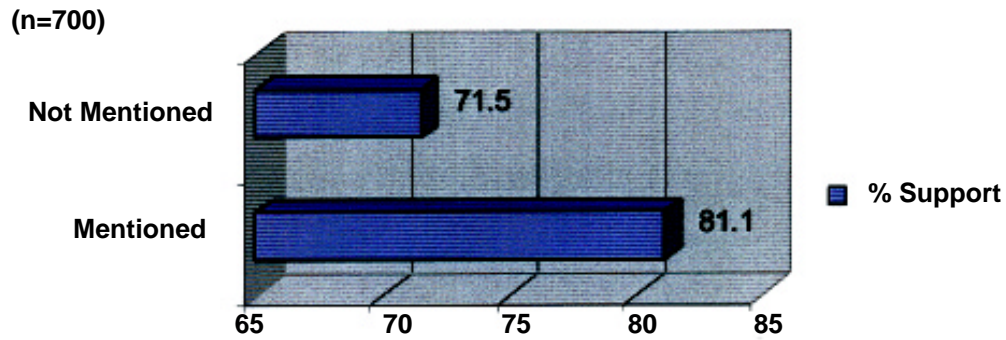


**Findings: Significant Differences and Correlations**

*Media Exposure and Opinions, Support for Additional Animal Agriculture*

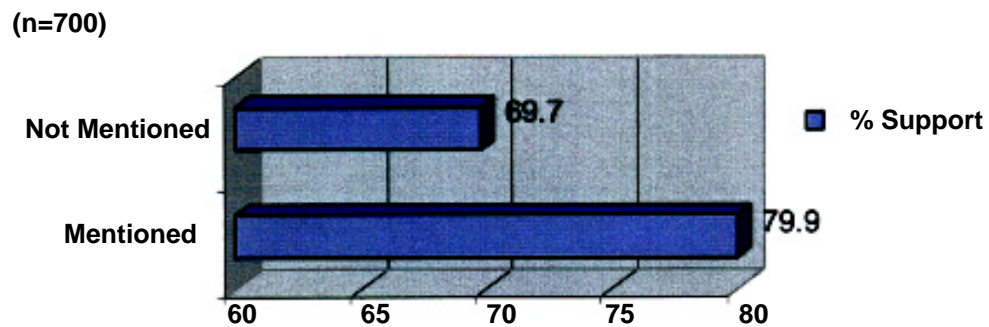
- Those who recalled a story in support of farming in South Carolina also supported animal agriculture in their counties (81.1 percent). There was less support among those who did not recall hearing such a story (71.5 percent; Figure 16, opposite).

Figure 16. Hearing a Story for Farming in South Carolina and Supporting Animal Agriculture



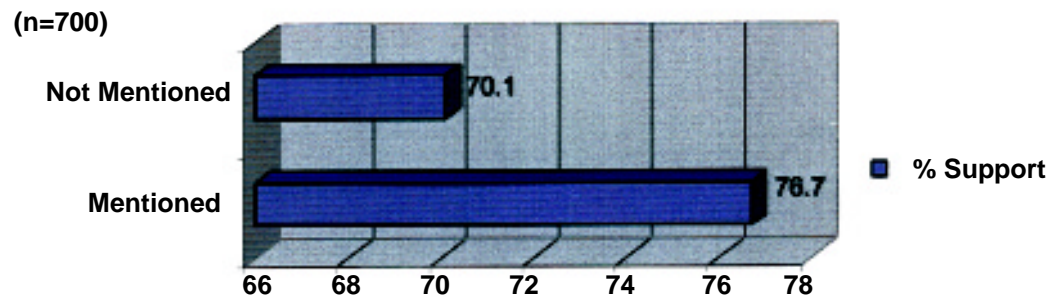
- Those hearing a story for farming in a nearby state were significantly more likely to say that they would support additional animal agriculture (Figure 17).

Figure 17. Favorable Farming Story, Nearby State, and Support for Animal Agriculture



The only other significant relationship between media stories and support for additional animal agriculture occurred with stories about animal rights in a nearby state. As depicted in Figure 18, 76.7 percent of those who recalled such a story also supported additional animal agriculture, while 70.1 percent of those who did not mention such a story did.

Figure 18. Story About Animal Rights, Nearby State, and Support for Animal Agriculture



In terms of mentioning a particular type of story related to animal agriculture and any significant relationship with a particular opinion statement, there were few statistically significant findings. These were

- Those who had heard a story about odor problems in a nearby state were more likely to agree that animal agriculture is a nuisance because of odor;
- Those who recalled hearing a story about polluted water in a nearby state were more likely to agree that animal agriculture causes environmental harm;
- Those who recalled hearing a story about animal treatment—in nearby states *and* in South Carolina—were more likely to agree that animal agriculture raises serious ethical concerns regarding the treatment of animals.

*Residence Type, Opinions About and Support for Animal Agriculture*

(It should be noted that in this sample, significantly more blacks (71.2 percent) currently resided in small towns or large towns/cities, while more whites (50.1 percent) lived on farms or in rural non-farm settings.

Statistical tests were conducted to see if any relationship existed between residence type (i.e., farm, rural non-farm, small town, large town/city) and attitudes about and support for animal agriculture.

- There was no significant relationship between residence type and support for additional animal agriculture.
- There were relatively few significant findings overall (Figure 19).
- People residing in a large town/city were most likely to agree that animal agricultural raises serious ethical issues about the treatment of animals and that better zoning and tougher environmental regulations are needed.
- Small town residents were most likely to agree that animal agriculture is a real nuisance because of odor.
- Farm residents were most likely to agree that their support of animal agriculture would be reflected in their voting and in expressing their views at public meetings (Figure 20).

**Figure 19. Opinions by Residence Type, Significant Findings Only (n=687)**

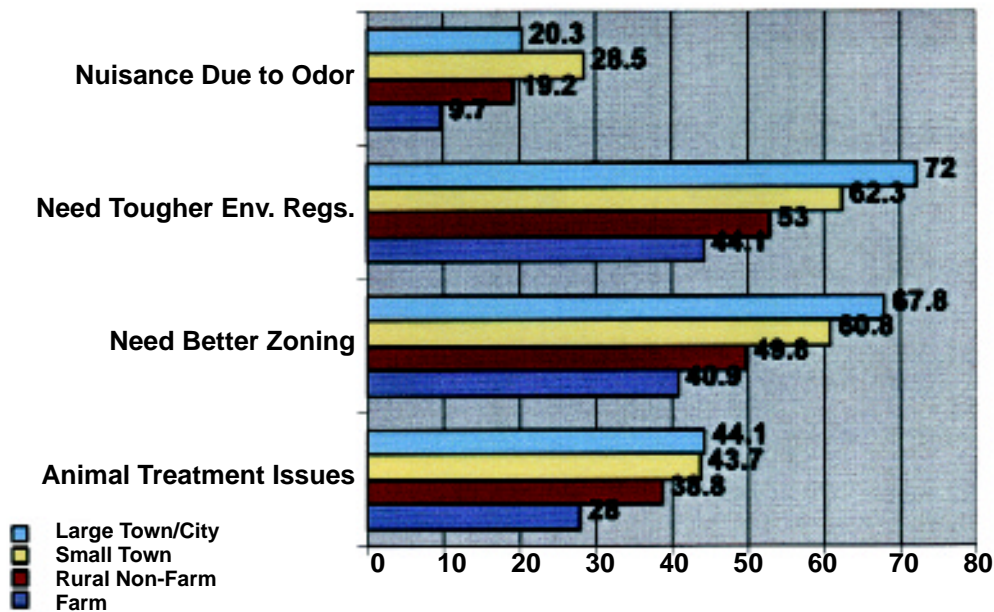
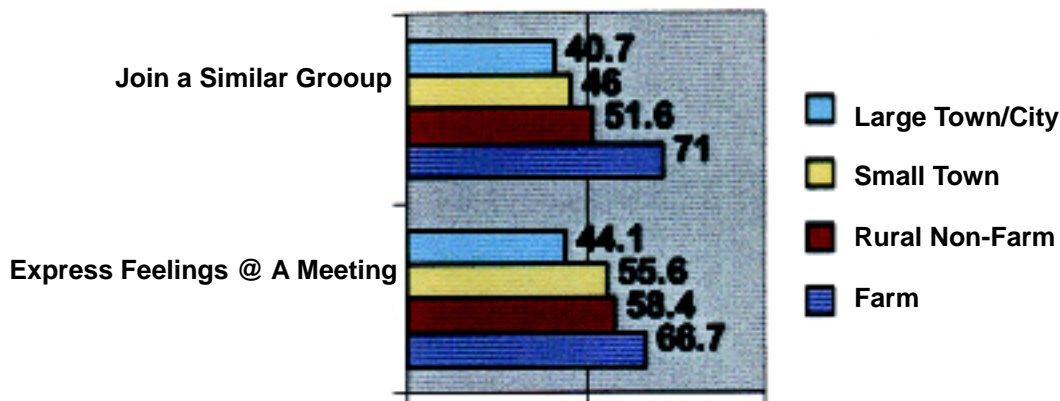


Figure 20. Support for Additional Animal Agriculture and Behavior, By Residence Type (n=686)



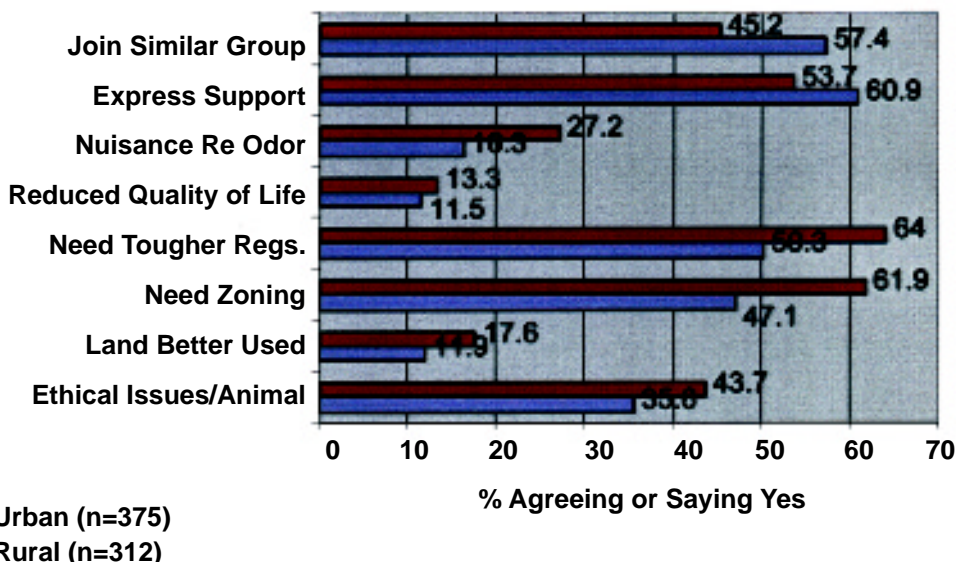
*Rural and Urban Views, Significant Findings Only*

For purposes of analysis, the residence categories of “farm” and “rural, non-farm” were combined to create the category “rural.” Residence types “small town” and “large town/city” were combined to create the category “urban.” Using these categories, 45.4 percent of the respondents were “rural” and 54.6 percent were “urban.” (See previous discussion of the sample, page 12.)

Figure 21 depicts only the findings that were significant by the rural-urban classification.

- Rural residents are more likely to express their support of animal agriculture at public meetings and to join groups with similar views about additional animal agriculture.
- Urban residents are more likely to agree that animal agriculture is a nuisance because of odor, that it raises ethical issues, that it has reduced their quality of life, that the land could be better used, and that zoning and tougher environmental regulations are needed.

Figure 21. Rural and Urban Views on Animal Agriculture, Significant Findings Only

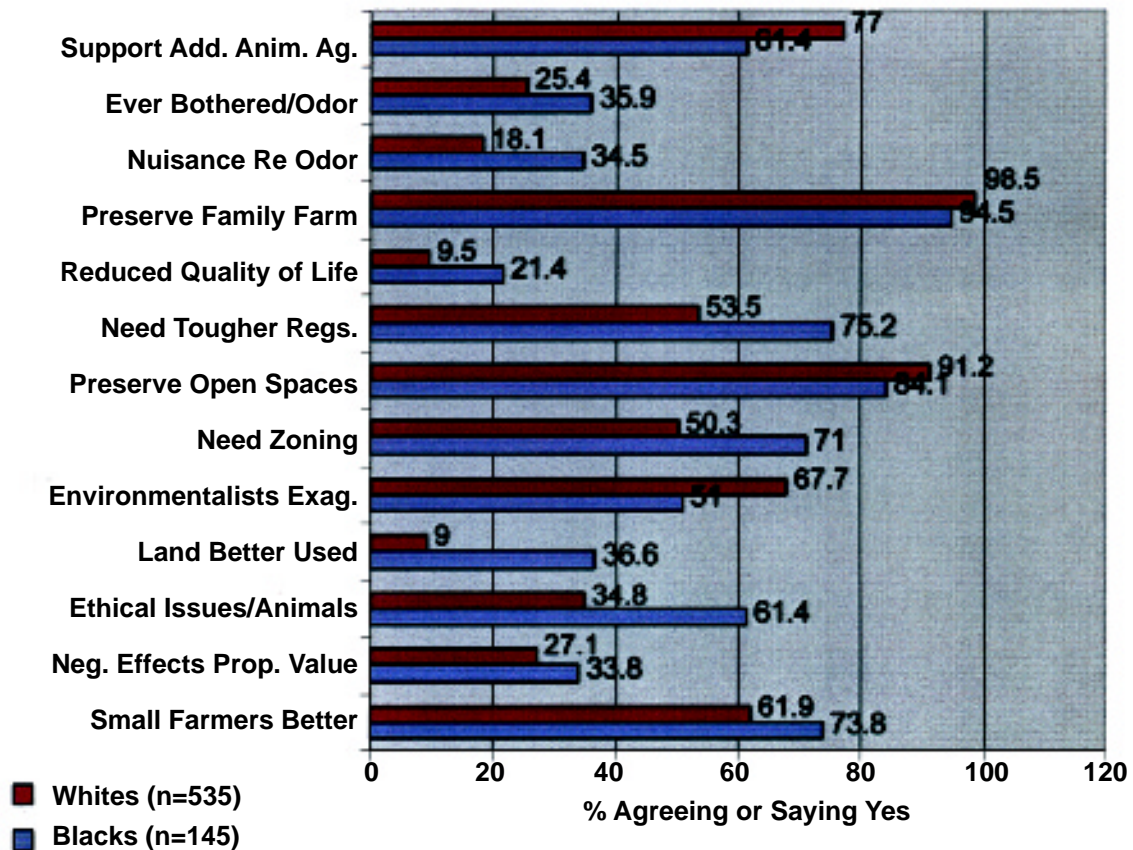




*Views of Blacks and Whites, Significant Findings Only*

- There were a number of significant differences in opinion by race (Figure 22).
- Blacks were more likely to agree that animal agriculture is a real nuisance because of odor, that they have been bothered by the odor, that tougher regulations and zoning are needed, that animal agriculture negatively affects property values, that animal agriculture has reduced their quality of life, and that animal agriculture raises serious ethical concerns.
- Whites were more likely to agree that they would support additional animal agriculture, that preservation of open spaces and the family farm are important, and that environmentalists exaggerate the problems associated with animal agriculture.

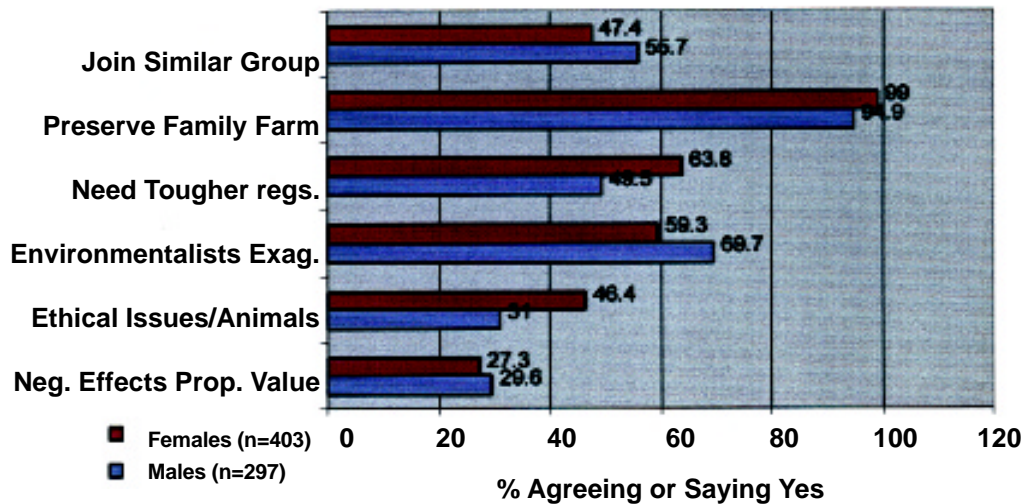
**Figure 22. Views of Blacks and Whites, Significant Findings Only**



*Significant Findings by Sex*

- There were few statistically significant differences by sex (Figure 23).
- More women agreed about the importance of preserving the family farm, that tougher environmental regulations are needed, and that animal agriculture raises ethical concerns.
- More men agreed that they would join a group with similar views about additional animal agriculture, that environmentalists exaggerate, and that animal agriculture has negative effects on property values.

**Figure 23. Views by Sex, Significant Findings Only**



*Significant Correlations by Selected Variables*

- Very few respondents indicated what percent of their income was derived from farming (n=74). Among those who did so, there was only one significant correlation. This was between percent farming income and agreeing that animal agriculture has reduced their quality of life. That is, the greater the percent income derived from farming, the more likely the respondents were to agree that animal agriculture had reduced their quality of life.
- The greater the distance from animal agriculture the more likely respondents were to agree that: zoning is needed; tougher regulations are needed; animal agriculture is a real nuisance because of the odor.
- The greater the distance from animal agriculture, the less likely respondents were to support additional animal agriculture.
- The higher the level of education, the less likely respondents were to agree that: small operators do a better job of protecting the environment; animal agriculture raises serious ethical concerns regarding the treatment of animals; land being used for animal agriculture could be better used for other purposes; their quality of life had been reduced by animal agriculture; property owners have the right to do what they want with their property; animal agriculture is a real nuisance because of odor.
- The older the respondent, they more likely there were to agree that: property owners have the right to do with their property as they wish; tougher regulations are needed around animal agriculture; the family farm should be preserved; people are working hard to reduce the environmental impacts of animal agriculture.

**Conclusions and Implications of the Current Study**

Based upon this study, it appears that animal agriculture has support in South Carolina. This support is strongest among whites, those who haven't been bothered by the odor of animal agriculture, and those living closer to animal operations.

At the same time that there is support for animal agriculture and optimism that people are doing their best to reduce animal agriculture's environmental impacts, there are those who think more zoning and tougher environmental regulations are needed. In addition, a relatively large minority of the respondents agreed that animal agriculture raises serious ethical concerns about the treatment of animals. Further, when choosing between five alternatives as new ventures for their counties, about twice as many people voted for plant crop agriculture as voted for animal agriculture.

Newspaper and television were the primary sources of stories about animal agriculture among the respondents in this sample. Overall, however, it appears that while exposure to stories was related to a few opinions (e.g., odor nuisance, environmental harm, animal treatment), the exposure was relatively unrelated to support for additional animal agriculture.

This study is limited to a random sample of 700 adult South Carolinians. It entailed an oversampling of the more rural counties in the state. The error margin is plus or minus four percentage points. Within these limitations, the findings suggest that while there is support for family farming and for animal agriculture in particular in the state, the opinions regarding such issues as zoning, environmental regulations, and the ethical treatment of animals are sufficiently strong enough to warrant further exploration.

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# Depicting Trends in South Carolina Animal Agriculture

*Christopher M. Sieverdes*

On June 30, 1998, a conference entitled “Animal Agriculture in South Carolina: The Real Poop” was held at the Pee Dee REC in Florence. The approximately 80 people in attendance represented a good cross section of producers, educators, regulatory agencies, environmental groups, and agricultural interest organizations. This section summarizes discussions among conference participants. The general question posed to attendees in small group discussion sessions was as follows:

## **What is the trend in animal agriculture in S.C. for next 5 to 10 years?**

- 1. Rapid Growth**
- 2. Moderate Growth**
- 3. Same as now**
- 4. Decline**

Attendees were also asked to give reasons why they responded in the way they did. They were asked to provide the rationale for their claim of future rates of growth or decline in the scope and intensity of animal agriculture in this state in the next decade. The question proved to be more of a stimulant for thought rather than a barometer of public opinion. There was no doubt among conference attendees that animal agriculture is undergoing massive change and that the general outlook for agriculture is fewer producers producing a high to moderate volume of products in an increasingly regulated, competitive, compacted environment where population density trends are up.

South Carolina animal agriculture will have to become more flexible, more sensitive to public perceptions, and more responsive to environmental regulations. South Carolina animal agriculture has to market its products as well as itself in challenging times. The national economy has been favorable during the past decade. We have the opportunity to shape our future in this positive economic setting.

When asked “**What will it take for animal agriculture producers to survive?**” respondents noted that financial issues, profit, cooperation among producers, educating the public, and educating producers were key factors which must continue to be addressed in coming years. Education about agriculture, increased funding for research and technology, the need to raise awareness regarding the role of animal agriculture in the state, the implementation of responsible farming and production practices, and enhanced communication with the public and legislators regarding the merits of animal agriculture were themes that ran through the discussions throughout the various groups.

## **Education of Youth, the Public, and Legislators**

Some participants noted that agriculture should be promoted in a positive manner to youth in order to increase their understanding of different elements of food systems and the economic structure. Many participants stated that educational efforts should be concentrated on the young people of our state since they are more removed from agricultural production and farm life than was the case one to two generations ago. Information that was common knowledge about farm life is no longer common.

There was agreement that there needs to be increased understanding of the regulatory environment of animal industries among residents in farm, suburban, and urban communities. This increased understanding should also extend to the halls of legislative bodies at the state and national level. It was noted that producers must also gain increased understanding at the same time.

One group noted that there should be a renewed emphasis on “Ag in the Classroom.” Others noted that the education process must include all parties: producers, commodity groups, public officials at the local level, legislators, regulatory (environmental) agency personnel, youth, urban populations, the “public” at large. There must be

greater understanding of data and data collection regarding the impact of animal agriculture from an economic perspective, an environmental perspective, a regulatory perspective, and a social and cultural perspective.

### **Coping Constructively with Change**

The recognition of the need to cope successfully with change was widespread. One means of bringing about change in the public arena is to form partnerships and understandings with other organizations, community groups, environmentalists, and agencies with regulatory responsibilities. Adoption of best practices and self-regulation are defined as far more favorable and “user-friendly” than practices imposed from outside the animal agriculture enterprise.

Change is ubiquitous. The need to cope with change without destructive and debilitating conflict is expected to become increasingly important for the foreseeable future. Changes place regulatory agencies in a pivotal position in terms of local government and business decision-making, formation of public policies, and infrastructure financing options. It is clear that the animal agricultural enterprises must become proactive in terms of environmental regulations and public interest on land conservation.

### **Increased Competition for Land and Land Uses: Land Use Planning**

Another important issue which received much discussion time dealt with the increasing competition for land within the borders of the state. Land issues, land use issues, zoning of land, urban sprawl, encroachment of residential development into established farming areas, and preservation of farm land were addressed frequently from different perspectives and vantage points. Competition for land in high growth areas of the state means that farms and other agricultural enterprises must co-exist with metropolitan-based value systems and increasingly urban and suburban uses.

Some participants voiced concern about the “right to farm” issue and “takings.” They noted that legislative bodies must understand the perspective of the producer who “was there first” and is financially strapped in an attempt to accommodate the demands and requirements of urban dwellers and environmental special interest groups. The costs of compliance are high.

### **Embrace New Technologies for Environmental Protection**

Conference participants recognized that the regulatory process is in transition and that the animal agricultural business sector must embrace new technologies to make business enterprises more efficient, more environmentally sound, and more acceptable to nearby residential and commercial property owners. This notion continues to be widely discussed by conference participants long after adjournment of the formal conference.

It is important for members of the agricultural production community to improve dialogue with the South Carolina Department of Health and Environmental Control. The South Carolina Department of Natural Resources is also a key agency for animal agriculture. Agriculturalists pride themselves on a legacy of land and water conservation. Participants at the conference see that this legacy must continue within responsible and enforceable regulatory standards. While the state is blessed with ample quality water, this positive situation must be sustained if the state is to remain competitive for economic development at the national level.

We must control odors and flies! New technologies and discoveries and creative options must be encouraged by the land grant system and state agencies. The land grant university must engage in research partnerships with animal agriculture industries to find new answers to old questions tied to economic and environmental issues.

### **Survival by Increasing Profitability**

This is a bottom line issue and must be given appropriate attention. Farmers must see profits within a span of years in order to finance improvements in their business operations. Adoption of new technologies is one

thing, but creating an opportunity where profit is probable is altogether something else to consider. An option for gaining more acceptance of new technologies to achieve environmental compliance is to review the role and relationship with commodity boards. It is noted that commodity boards have a significant role to play in the production side of animal agriculture in this state and others which produce similar commodities. In many ways this can also be a means of sending a positive public message through the animal industry regarding the success of South Carolina animal agriculture.

### **Engage in Positive Public Relations**

Success stories must become publicized. The public relations approach also calls for education of the public, the economic development community, and policy makers. Part of the solution will involve alternative crops and the application of “good science” from the land grant university system.

Other alternatives and strategies include discussion about niche marketing, improving economies of scale, increasing farm prices, gaining new market access, and “cooperation through desperation.” Means must be found to make “cooperative” ventures, constructive vertical integration arrangements, and well-constructed contracts more accessible to producers.

Risk management is an art and a science. Farmers must become better managers, and they must be encouraged to follow the innovators. The success of “Early Adopters” must be viewed as a public relations opportunity for all of animal agriculture.

In short, the conference small group discussions were marked by cautious optimism. Many goals and solutions were discussed at length and participants seemed prepared to meet the challenge of the next decade.

# Spatial Relationships of Polluted Streams, Animal Agriculture, and Human Populations in South Carolina Watersheds

*Jeffery Allen, Kang Shou Lu, and Sean Blacklocke*

Much has been written recently in the popular press about agriculture and its negative or harmful affects on the environment. Problems in North Carolina associated with confined pork production facilities and degradation of streams adjacent to these facilities seem to have affected the perception of agriculture across the Southeast if not the entire nation. The Clinton Administration's 1998 Clean Water Initiative and recent South Carolina law require revision and increased enforcement of effluent guidelines and rules for all animal feeding operations, in part because of the perception that these operations contribute significantly to nonpoint source pollution. Because of these and numerous other reasons, the authors of this section wished to determine if animal feeding operations contribute significantly to the nonpoint source pollution problem in South Carolina.

This component of the overall agricultural perceptions study attempted to determine whether or not spatial relationships existed between areas of the state where large numbers of agricultural animals are concentrated and water quality by watersheds. The authors also examined the human population in the same context. The study area was limited primarily to the state of South Carolina, though some of the watersheds analyzed crossed political boundaries into North Carolina and Georgia.

All project data were analyzed using Arc/Info and ArcView geographic information systems (GIS) software. The following datasets were either used in the final analysis or used to determine which datasets were necessary for the project. The 1992 Agricultural Census was utilized to obtain total numbers of cattle, total numbers of hogs, and total numbers of chicken farms. The data for each category were broken down by zip code in order to provide the finest spatial resolution (highest level of detail) possible for the state. Stream or hydrological data were aggregated to 8 digit hydrologic units thereby forming 34 separate watersheds. Aggregating hydrologic data was necessary in order to reduce the data volume associated with the thousands of streams in the state.

The map titled "Index of Watershed Indicators" depicts the watersheds used in this study. Initially the project team used U.S. Environmental Protection Agency (EPA) water quality data tagged to the 8 digit hydrologic units. However, it was determined the EPA data were generalized to include all forms of contaminants and would not accurately portray potential water contamination by agricultural animals. The project team decided to use selected South Carolina Department of Health and Environmental Control (DHEC) Clean Water Act 303(d) data as the indicator of water quality impairment.

Data used from within the Department included the following:

- Water chemistry data from 700 surface water and sediment monitoring sites
- Approximately 500 shellfish growing monitoring sites
- Fish, oyster, and crab tissue monitoring data
- Stream macroinvertebrate assessments
- Discharge Monitoring Report data
- Lake eutrophication monitoring data
- Environmental Surveillance Oversight Program (Savannah River Site)
- Nonpoint Source (319) data from State Nonpoint Source Management Plans 304(l) Short List
- State Watershed Water Quality Management Strategies
- State Shellfish Restoration Committee
- Special studies or general knowledge

After considering the potentially relevant indicators of stream impairment, the project team decided that fecal coliform bacteria (an indicator of levels of animal waste pathogens) and dissolved oxygen (an indicator of levels of oxygen-demanding pollutants) would be the measures most closely linked to animal agriculture.

Phosphorus was not used as an indicator because of the very rare incidence of elevated levels of phosphorus in South Carolina streams. Nitrogen was not used because recent work completed by the U.S. Geological Survey's (USGS) National Water Quality Assessment Program has shown for at least three of the five major river basins in South Carolina, nonpoint source nitrogen loads are significantly heavier from the atmosphere than from manure and fertilizer. Other measures like metals and chemical pollutants were not used because it is thought that they would not be indicative of animal agriculture land use. Measures of impaired use collected by DHEC but not used in this study include phosphorous, cesium, chromium, copper, hydrogen ion concentration, macroinvertebrates, mercury, contaminated sediments, pesticides, strontium, and zinc.

If any stream within a watershed was considered impaired for use because of fecal coliform or dissolved oxygen, the entire watershed was labeled as impaired by that particular condition. Impaired streams as defined by DHEC fall under four categories: 1) Impaired for Recreational Use (Swimming), 2) Impaired for Recreational Use (Fish Consumption), 3) Impaired for Recreational Use (Shellfish Harvesting), and 4) Impaired for Aquatic Life Use. Again, streams were considered impaired if fecal coliform or dissolved oxygen impaired any of the four use categories. Once the impaired watersheds were identified, the different animal population numbers as well as the human population numbers were overlaid to determine spatial relationships between water quality degradation and animal concentrations.

## **Results**

The final analysis produced nine maps of new information regarding South Carolina's waterways and animal agriculture. The first map, as mentioned earlier, is the "Index of Watershed Indicators" containing the EPA water quality data. Again, the data represented here are too generalized for in-depth analysis but does show generally good water quality for the majority of watersheds in South Carolina. The remaining maps can be categorized into two broad groupings: animals and humans related to dissolved oxygen impairment and animals and humans related to fecal coliform bacteria impairment.

### **Dissolved Oxygen**

When examining the dissolved oxygen maps one finds the majority of problems in the coastal watersheds as well as the Lower Catawba, Lower Pee Dee, and Enoree watersheds. The Lower Catawba (Charlotte, NC), the Lower Pee Dee (Florence, SC), and Enoree (Greenville/Spartanburg, SC) are all associated with urban areas as are the coastal watersheds. Notable exceptions to this pattern are the watersheds adjacent to the Columbia, SC, metropolitan area and the Aiken, SC/Augusta, GA, areas. One explanation of this pattern is that many of the older coastal urban areas have problems with combined sewer overflows, where sanitary wastewater lines and stormwater lines run together and their overflow empties into streams. Newer systems inland better separate and contain the sanitary sewer system and the stormwater sewer system. Other dissolved oxygen problems are thought to be associated with urban runoff.

What is clear from these maps is that the spatial relationship between impaired streams for dissolved oxygen and concentrations of hogs, cattle, and chicken farms is not strong, whereas the spatial relationship between the human population and impairment for dissolved oxygen appears to be significant.

### **Fecal Coliform Bacteria**

The maps showing impaired waters from fecal coliform bacteria revealed a different pattern of problems than the dissolved oxygen maps. Once again, many of the same watersheds associated with or adjacent to urban areas turned out to contain fecal coliform problems. The total number of watersheds with problems increased, with the notable exception of watersheds downstream from the Columbia, SC, metropolitan area. The spatial correlations between hogs and chicken farms and water use impairment from fecal coliform bacteria appear very low. However, the spatial relationship between cattle and fecal coliform bacteria appears to be significant. In addition the relationship between human population and fecal coliform bacteria impairment appears to be significant, especially in the upstate watersheds.

## **Implications**

It has been reported recently that agriculture impairs 70 percent of United States rivers and streams and that animal feeding operations are a significant contributor. The maps produced from this study indicate something to the contrary, at least in South Carolina. In South Carolina, it is the urban areas that are most closely linked to dissolved oxygen and fecal coliform bacteria problems.

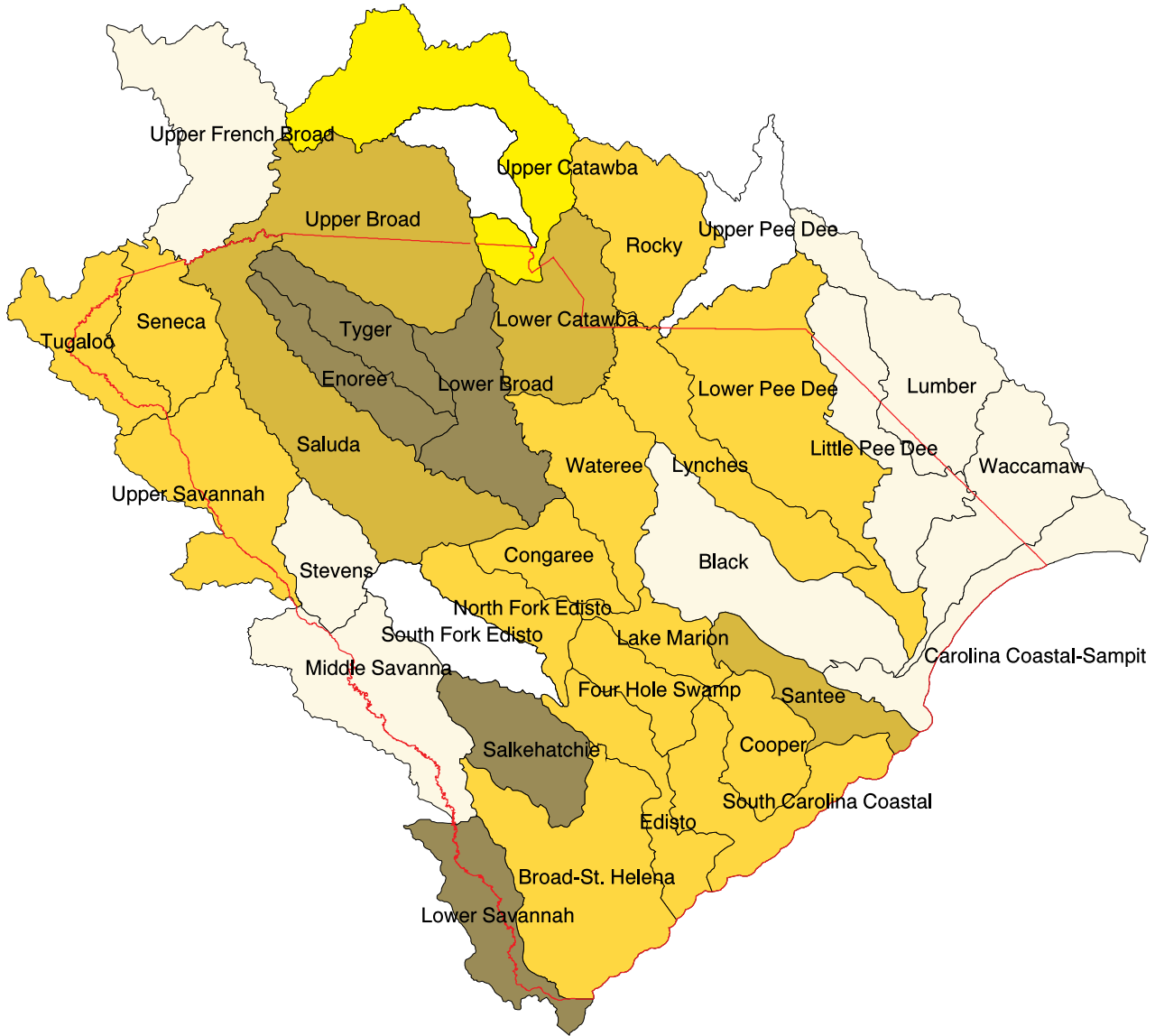
President Clinton's Clean Water Initiative and new DHEC regulations primarily aim to reduce nonpoint source pollution from animal feeding operations. Data from EPA, USGS, and USDA clearly show that the potential for problems with animal feedlot runoff is exclusive to a relatively small number of states, not including South Carolina. The authors (of this section) suggest that Federal dollars potentially appropriated through the Clean Water Initiative to South Carolina might be better spent enforcing existing regulations on industries and municipalities, rather than enforcing new regulations on agricultural enterprises to correct problems that do not seem to exist. Stringent new state regulations that have just been put into effect in South Carolina reduce the need for Federal interference.

A limitation of this analysis is that the 1992 Agricultural Census data on animal concentration by zip code are outdated. A previous section of this Fact Book points out that animal numbers in the state have grown very slowly since 1992. Nevertheless, it would be beneficial for this analysis to be updated with the new data that will soon be available from the 1998 Agricultural Census.

# Agriculture and Environment

## Index of Watershed Indicators

### South Carolina



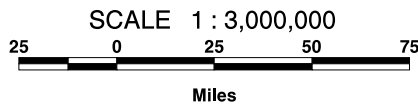
Better  
Water  
Quality



More Serious  
Water Quality  
Problems

**Data Sources:**

- EPA
- Census Bureau
- Agricultural Census
- Strom Thurmond Institute

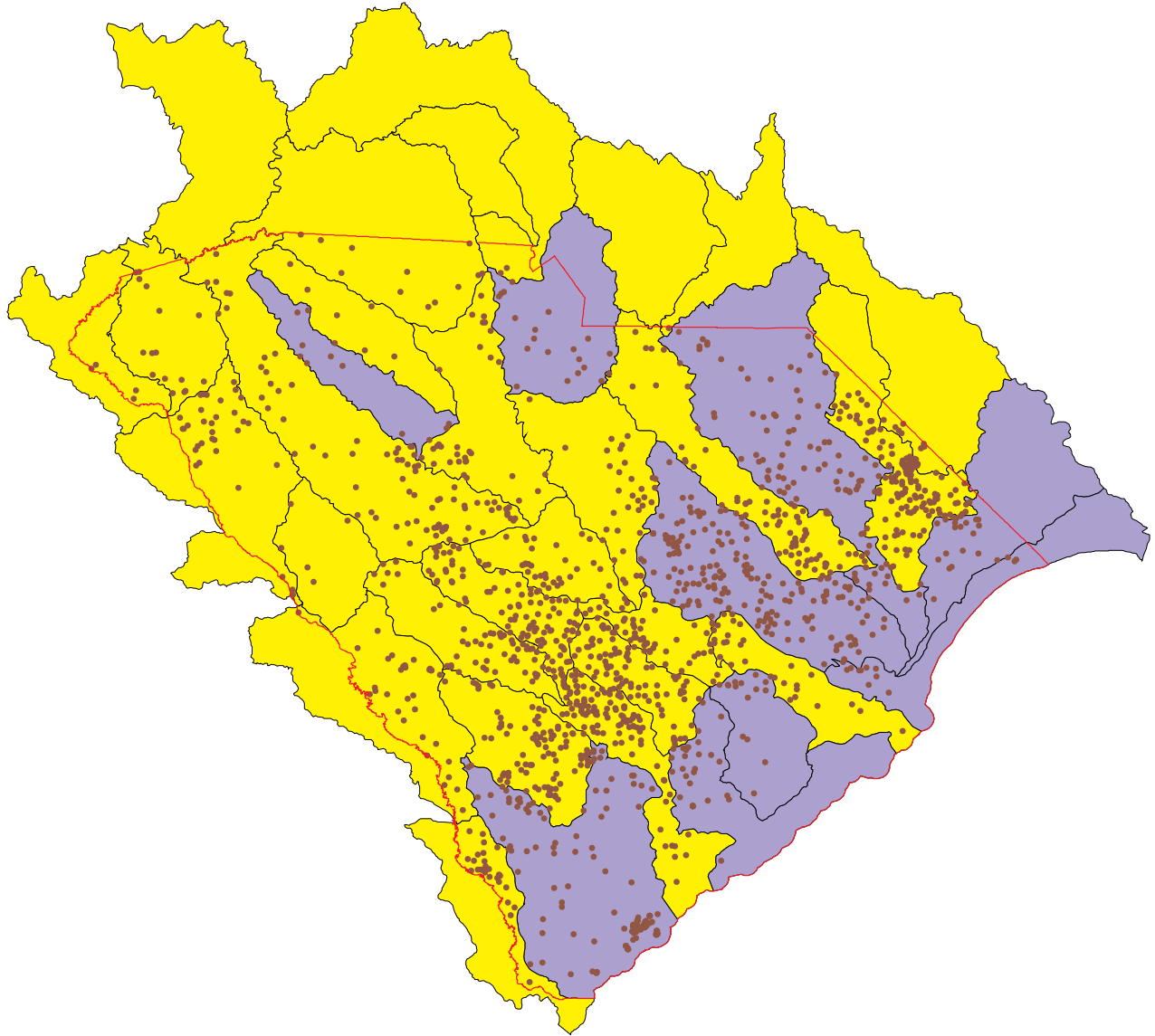


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

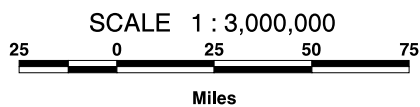
## Impaired Watersheds for Hog Population and Dissolved Oxygen

### South Carolina



Hog Population  
• 1 Dot = 100  
Dissolved Oxygen  
■ With DO problems  
■ Without DO problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute



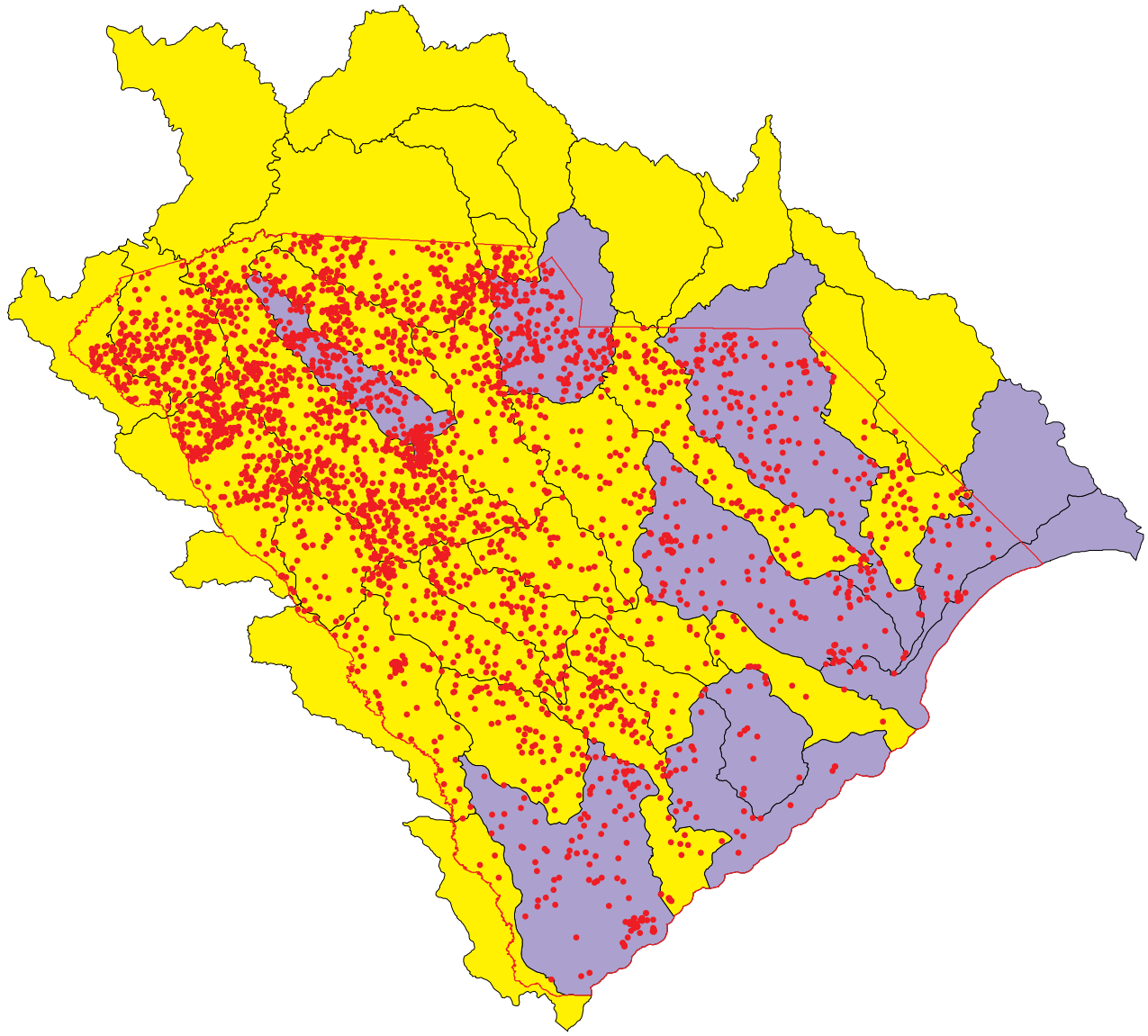
Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998



# Agriculture and Environment

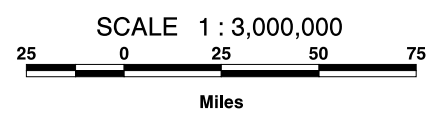
## Impaired Watersheds for Cattle Population and Dissolved Oxygen

### South Carolina



Cattle Population  
• 1 Dot = 150  
Dissolved Oxygen  
■ With DO problems  
■ Without DO problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute

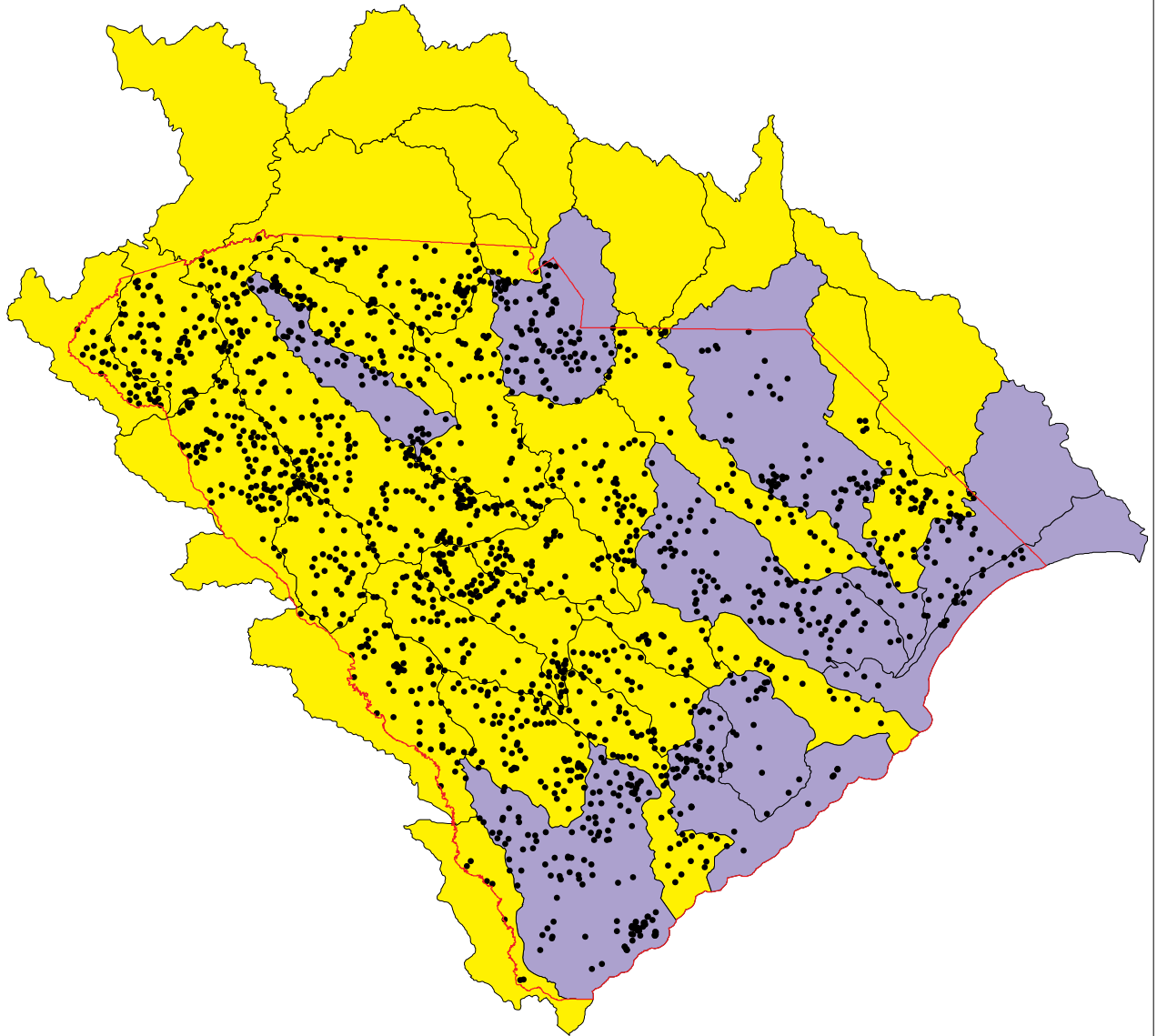


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

## Impaired Watersheds for Chicken Farms and Dissolved Oxygen

### South Carolina



Chicken Farms  
• 1 Dot = 1  
Dissolved Oxygen  
■ With DO problems  
■ Without DO problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute



SCALE 1 : 3,000,000  
25 0 25 50 75  
Miles

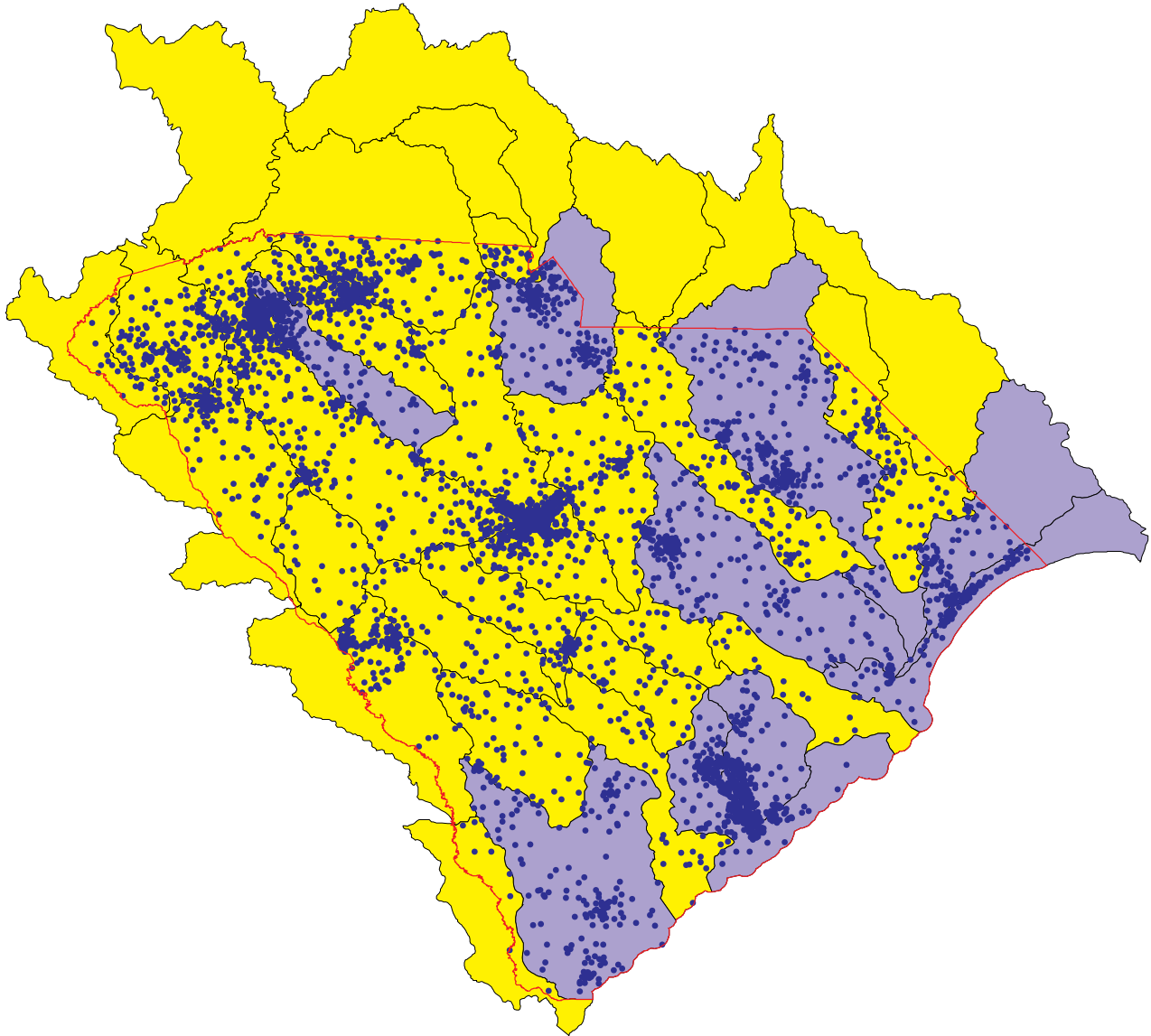


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

## Impaired Watersheds for Human Population and Dissolved Oxygen

### South Carolina



Human Population  
• 1 Dot = 750  
Dissolved Oxygen  
■ With DO problems  
■ Without DO problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute



SCALE 1 : 3,000,000  
25 0 25 50 75  
Miles

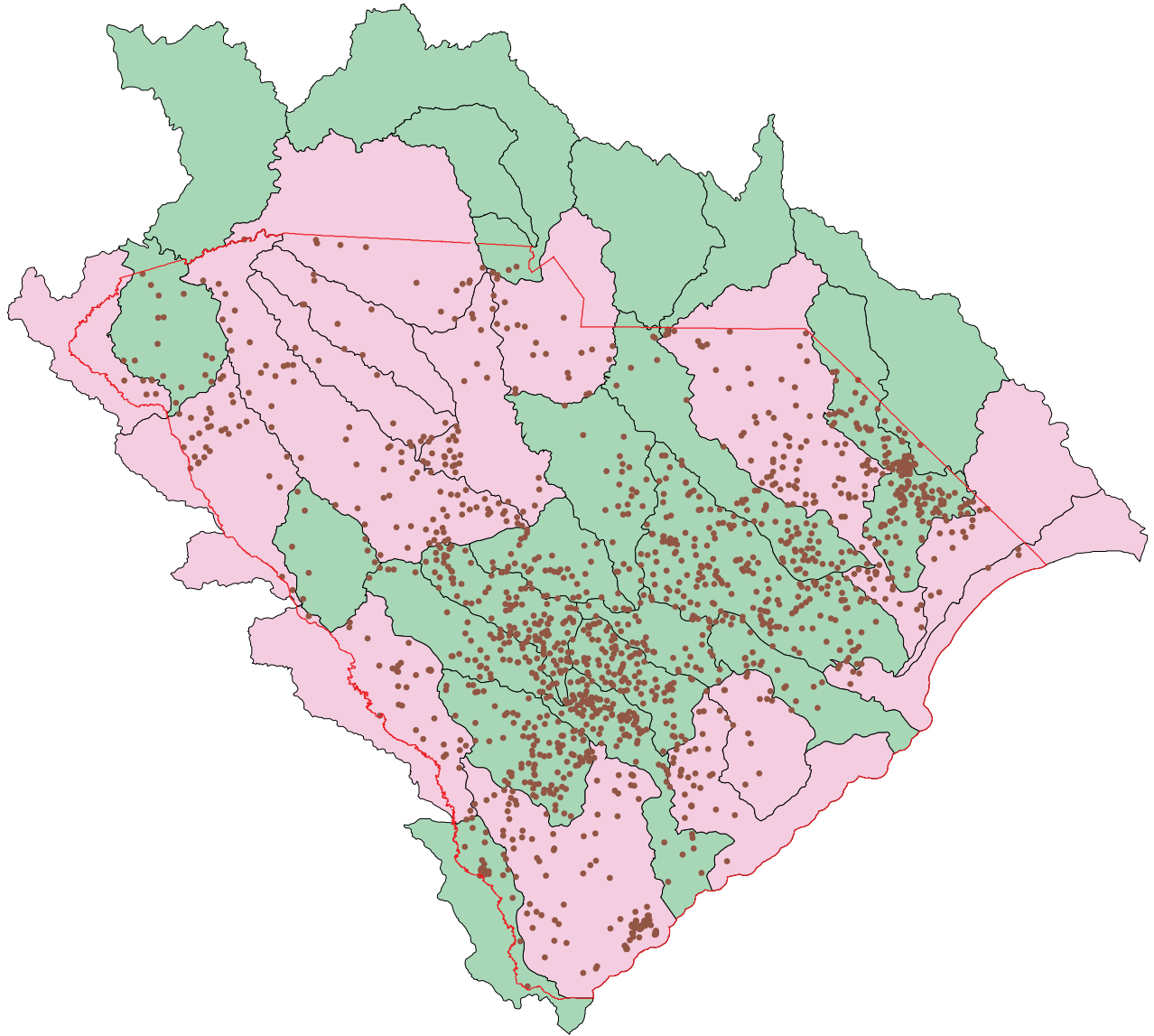


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

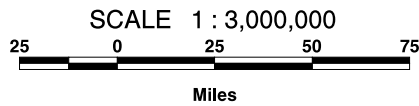
## Impaired Watersheds for Hog Population and Fecal Coliforms

### South Carolina



Hog Population  
• 1 Dot = 100  
Fecal Coliforms  
■ With FC Problems  
■ Without FC Problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute

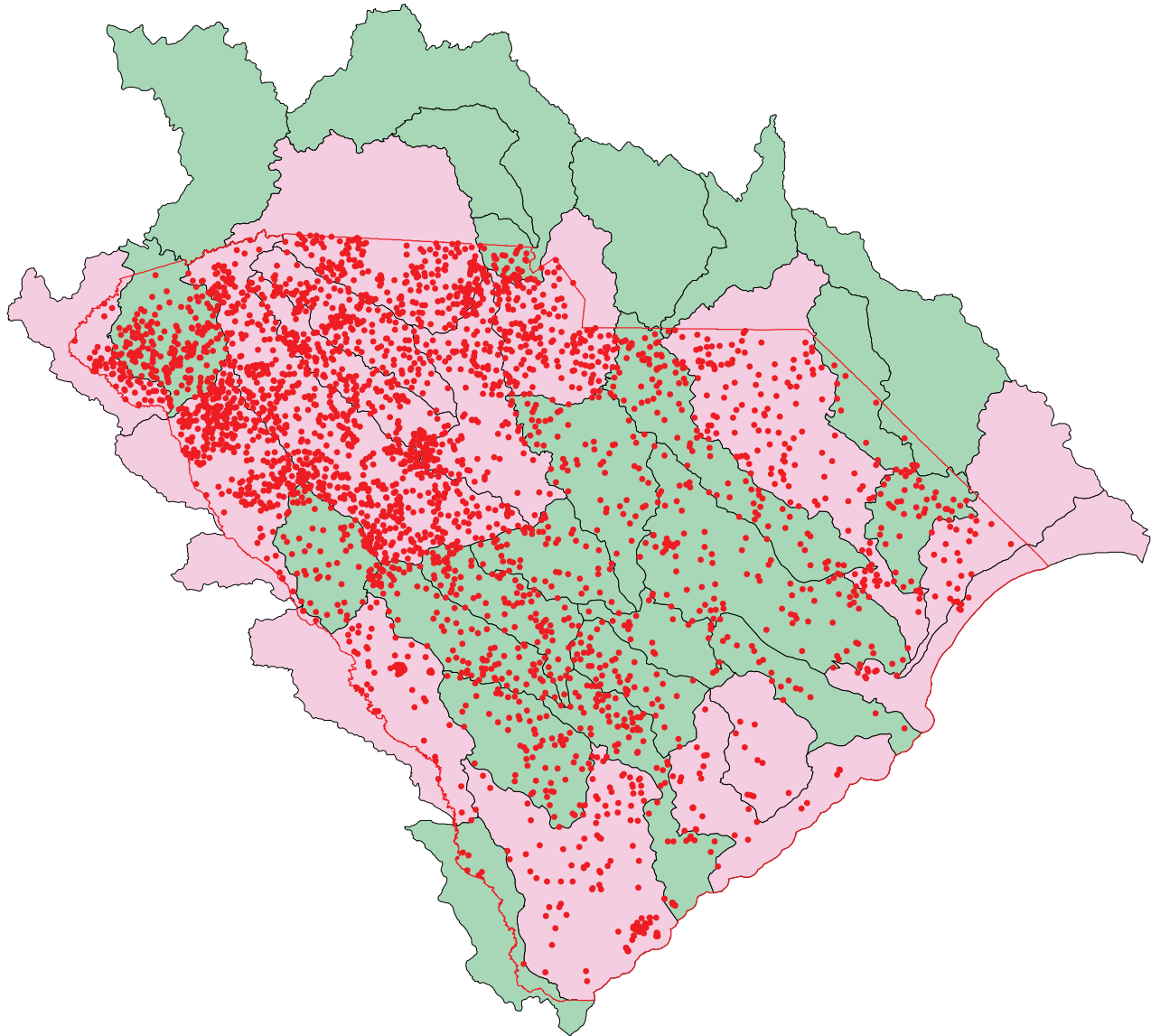


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

## Impaired Watersheds for Cattle Population and Fecal Coliforms

### South Carolina



Cattle Population  
• 1 Dot = 150

Fecal Coliforms  
■ With FC Problems  
■ Without FC Problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute



SCALE 1 : 3,000,000

25 0 25 50 75

Miles

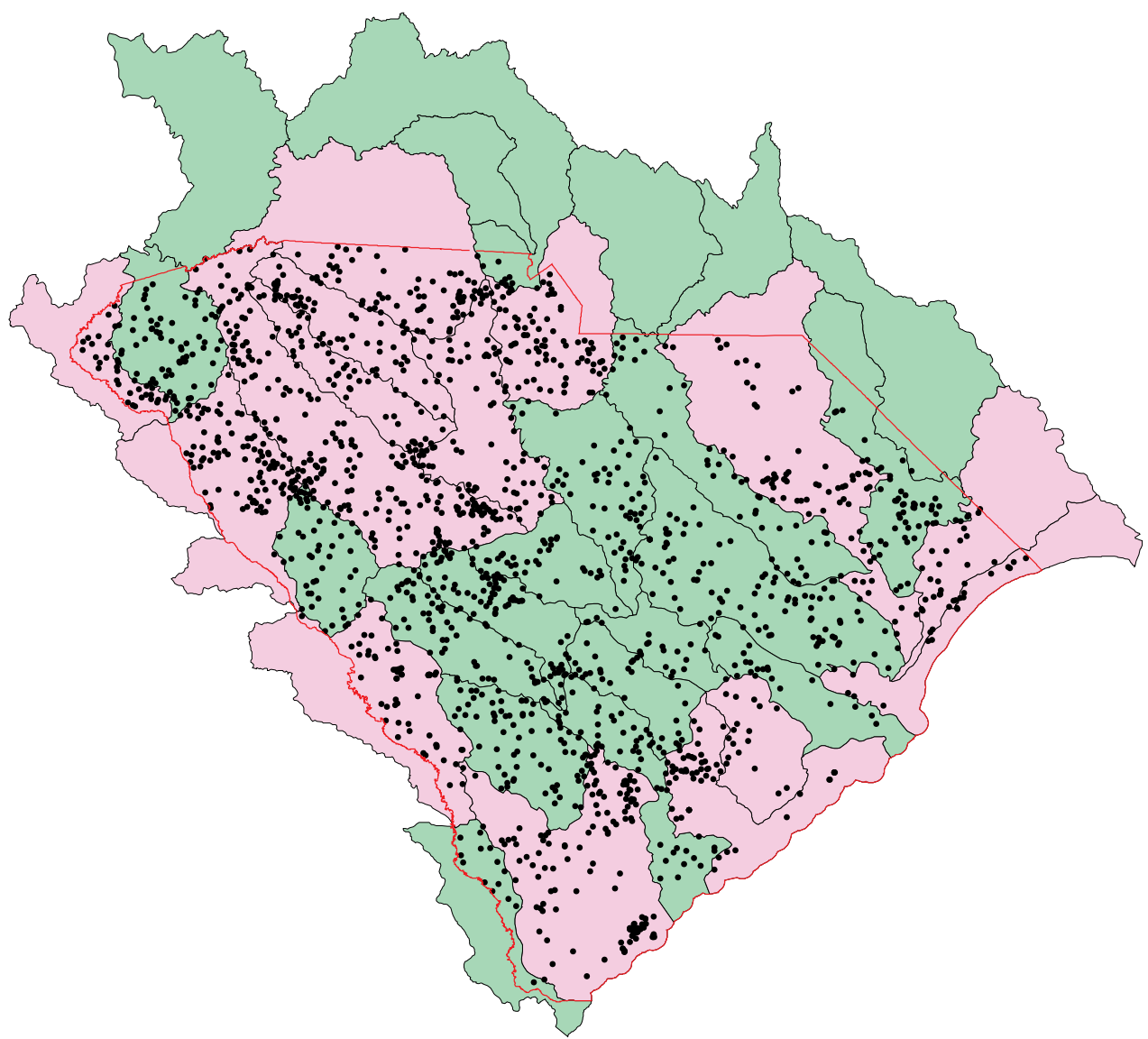


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

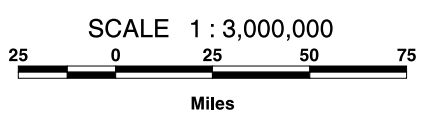
## Impaired Watersheds for Chicken Farms and Fecal Coliforms

### South Carolina



Chicken Farms  
• 1 Dot = 1  
Fecal Coliforms  
■ With FC Problems  
■ Without FC Problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute

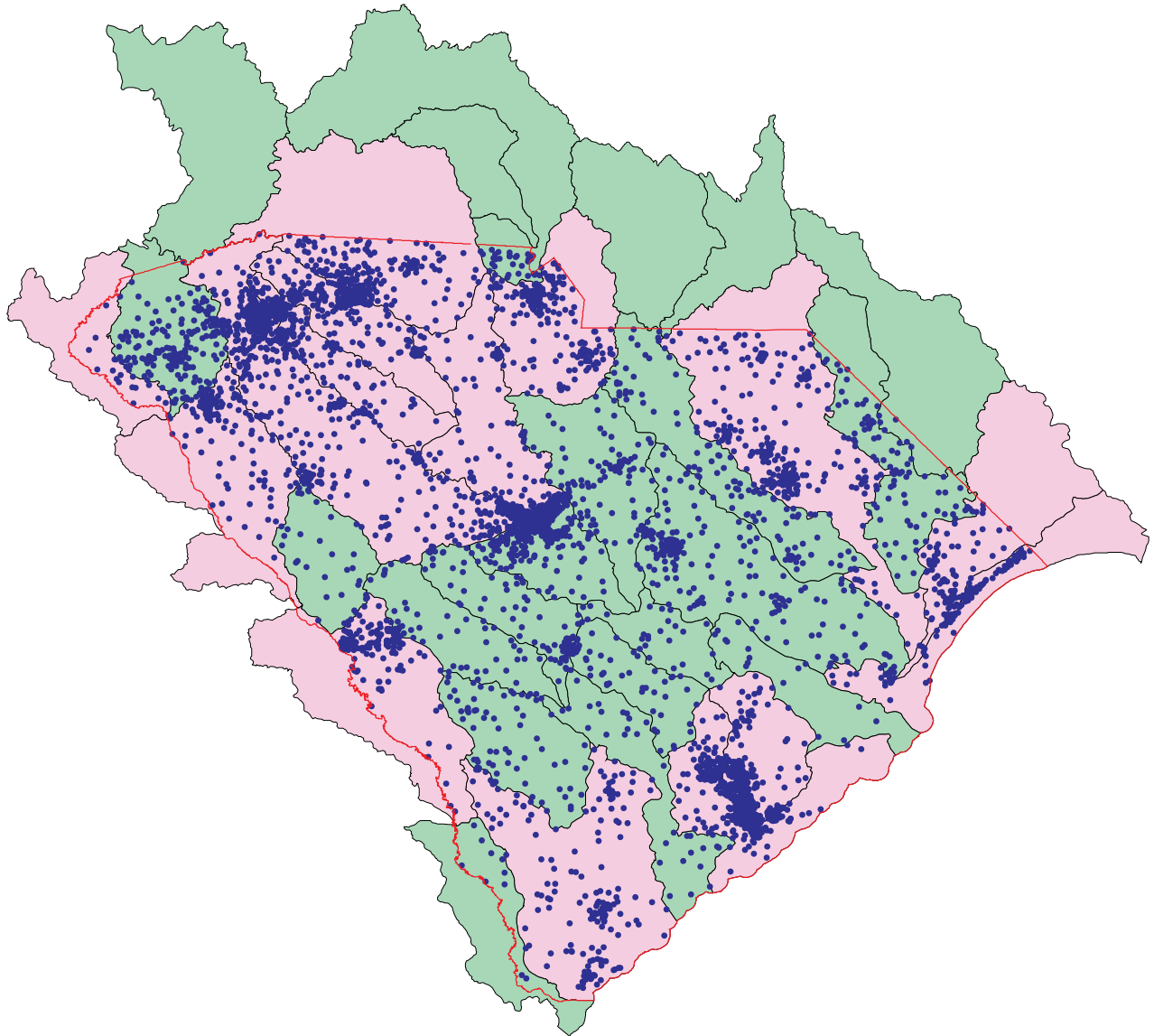


Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998

# Agriculture and Environment

## Impaired Watersheds for Human Population and Fecal Coliforms

### South Carolina



Human Population  
• 1 Dot = 750

Fecal Coliforms  
■ With FC Problems  
■ Without FC Problems

Data Sources: EPA  
Census Bureau  
Agricultural Census  
Strom Thurmond Institute



SCALE 1 : 3,000,000

25 0 25 50 75

Miles



Map produced by Spatial Analysis Laboratory, Strom Thurmond Institute, 1998



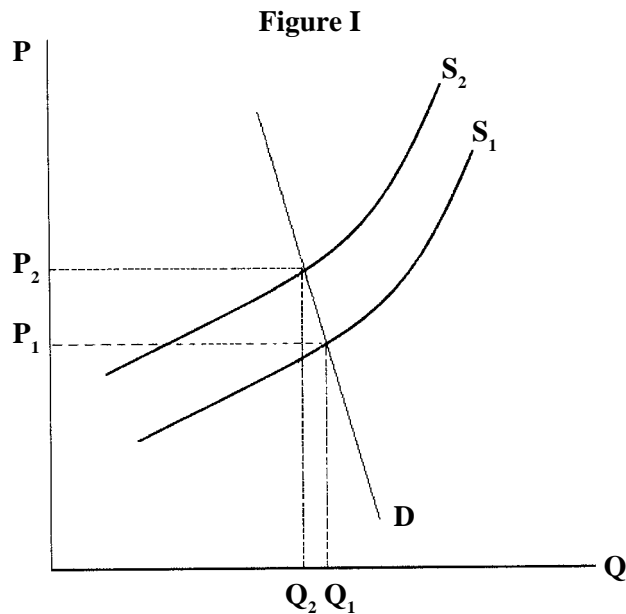
# Economics of Regulating Animal Agriculture

*Mellie L. Warner*

Stricter regulation of animal agriculture and other sources of nonpoint pollution is almost certain to occur in the next few years. "Industry" was targeted as the main pollution source for many years. But now that industrial pollution is under control to a greater or lesser extent, the problems of nonpoint pollution have become a key issue. Although agriculture has occupied a special place in American society over the centuries, recent trends have been to treat it no differently than other forms of production. The percentage of the American population living on and employed on farms has been in decline almost since the first settlers set foot on shore (except for a small deviation from trend in the 1930's and 1940's). This trend will continue. In fact the growth in the productivity of agriculture is in many ways the foundation on which the industrial revolution and now the information revolution have taken place<sup>5</sup>. If one American farmer couldn't feed so many people, fewer workers would be available to bring us all the other good things in life. But it has been difficult for the people still in agriculture to be subject to constant change without any chance of reaching a new equilibrium.

Despite the inevitability of change and the probability of increased regulation, farm groups will probably oppose new environmental regulations. However, studies have shown that new regulations and the threat of new regulations can be the catalyst for improved technology. And in some cases the new technology can reduce costs as well as pollution. (See Porter and van der Linde<sup>6</sup>.) The first firms to discover and utilize new technologies can sometimes position themselves well market-wise while the others play catch up. South Carolina may be in a position for such benefits to the extent its new animal agriculture regulations anticipate potential Federal standards.

Farmers complain that they will be unable to pass along the costs of pollution control to their customers. While this would be true for any individual farmer, it would not be true for the industry as a whole. In economic jargon, the market demand for agricultural commodities tends to be inelastic. Wohlgenant<sup>7</sup> estimated own-price elasticities for animal food products to be between -.15 and -.76. This means that a 10-percent increase in the price will result in only a 1.5- to 7.6-percent decrease in consumption. So the demand for each individual group of animal food products is inelastic, and the demand for animal food products as a whole is even more inelastic as there are few substitutes for meat as a food group. Thus, the outcome of a cost-increasing new regulation would be an increase in price as illustrated in Figure I. Because of the inelastic nature of demand, aggregate income to farmers ( $P_2 \times Q_2$ ) exceeds the original income level ( $P_1 \times Q_1$ ). But it is important to note that in the transition to a new equilibrium, farms with the highest costs will go out of business.



Others argue that in past cases when costs have risen, the farmers have borne the burden because the intermediaries did not raise prices paid to farmers. This should be a short-run phenomenon. Higher grain prices are usually a temporary problem and farmers will not make long-run resource allocation decisions based on them. And in the short run, it is hard to adjust animal numbers downward except by increasing marketings. This pushes animal prices down in the short run. But a permanent, long-run change in supply curves due to increased regulation should result in higher prices to producers that will cover most of the increased costs, though there may be some decrease in quantity.

There is even some possibility that regulations would decrease volatility in animal product markets. It would be more difficult to increase animal numbers in response to improved market conditions. This truncation of the upward swing of the hog cycle would dampen the crash that can result from overproduction.

In the extreme case where demand was perfectly inelastic, the equilibrium market quantity would not change and price would increase to cover all the costs of pollution reduction. While this is unlikely, the inelasticity of demand dictates that price would adjust more than quantity. Since everyone eats, the costs as well as the benefits of pollution reduction will be widely spread over the population.

If we look at world demand for United States animal food products, we will find it to be more elastic than domestic demand. Higher prices in the United States will have a bigger impact on exports than on domestic consumption, and some production will move overseas. While Americans benefit from low food prices when pollution regulation is lax, they do not directly benefit from low prices enjoyed by the rest of the world. So while the costs of pollution associated with domestically consumed products are partially offset by the benefits of lower food prices, this is not true for exported products. Thus, if regulations in the United States are stricter than in the rest of the world, exports will suffer just as differences in the strength of regulations between the states causes relocation of animal agriculture. Environmental concerns are likely to be a major focus of the next World Trade Organization negotiation round.

Perceptions are important to animal agriculture. The best way to avoid regulation is probably to be “good stewards” in the first place. The algae “bloom” in Lake Okechobee in Florida several years ago provided the impetus for stricter, costly regulation of dairies north of the lake. Similar pollution in the Chesapeake Bay may provide the motivation for new national standards. Even the National Pork Producers Council has come to see that animal agriculture regulation is inevitable and they are better off working with the regulators rather than against them. For example, the NPPC is sponsoring an Odor Solution Initiative Program. If increased regulation is inevitable, the best course for agriculture is probably to throw its energy behind finding new and innovative ways to protect the environment that are not prohibitively expensive. The land grant colleges and USDA are working along with commodity groups and agribusiness to find new methods of manure management.

Given the rising levels of “contracting” between farmers and meat processors, there is a role to be played by the large meat processors. They could take the lead in ensuring that their growers act in environmentally responsible ways. At least one processor is known to have removed hogs from a farm that did not follow the proper environmental controls as specified in their contract. Part of the \$6 million settlement by Tyson Foods, Inc., in Maryland is the provision of \$300,000 to about 240 contract chicken growers to control manure runoff.<sup>8</sup> Perhaps some sort of environmental “certification” program could be developed. Studies of other commodities have shown a willingness on the part of some consumers to pay a premium for items such as organic produce. The Clean Water Action Plan mentions the possibility of “Blue Water” labeling for agricultural products.

Pollution regulations must be carefully designed. Sunding<sup>9</sup> argues that regulations should not be uniform but should vary according to local conditions including season. USDA’s EPIC<sup>10</sup> (Erosion/Productivity Impact Calculator) model may be of use in designing regulations that can be customized for soil type, climate, proximity to waterways, etc. This could eliminate concerns that regulations will be based on only one region’s technological requirements.

Another idea is to tax inputs rather than outputs (Larson, et al.<sup>11</sup>) They argue that taxes should be placed on the input with 1) the highest elasticity of demand with respect to price and 2) the highest elasticity of pollution with respect to input. This will be the most efficient input to tax and the welfare loss from not taxing all inputs may be

small. Shortle and Dunn<sup>12</sup> found that a tax or subsidy on management practices is more efficient than restrictions on management practices, or taxes or restrictions on runoff. Incentives for management practices are also more efficient when there are multiple sources of pollution or when risk aversion exists.

Griffin and Bromley<sup>13</sup> found that the amount of pollution in runoff could be estimated from production functions for individual farms given their production activities. If we could determine the nonpoint pollution production function for each farm, we could tax accordingly. Or perhaps we could set a number of pollution units allowed for an area (watershed?) and auction them off. An NCSU study<sup>14</sup> of a nutrient trading program under the Clean Air Act in the Tar-Pamlico River Basin indicates the potential value of such an approach. However, the basis of the current animal agriculture regulatory framework is “zero discharge,” at least under normal operating conditions. This works against innovative concepts such as trading or selling nutrient emission rights—zero can’t be traded.

When the activities of one group have a positive or negative impact on another (usually neighboring) group, economists call it an externality. Two kinds of externality that can be produced by animal agriculture and are of concern to citizens are water pollution and air pollution, often in the form of unpleasant odors. Even an unsightly farm would be considered an externality by many people. Together they can affect the quality of life and possibly long-term health. When a negative externality exists, someone is not paying the full costs of their activity. If a farmer uses clean water and then returns polluted water to the nation’s waterways, he has not paid the full costs of using the water which would include returning it to its prior condition.

Often discussions of externalities are framed in terms of property rights. Does the farmer have the right to dirty the water or do the people downstream have the right to have clean water? Do farmers have the right to put foul odors into the air, or do the neighbors have the right to have clean air? Regulations tend to redistribute property rights and therefore create winners and losers. This is one reason why the government offers cost-sharing programs—to help offset the property rights losses incurred by farmers. A recent survey (June-November 1997) by the American Farmland Trust found that most farmers had not suffered any “loss of value due to government regulations such as zoning, erosion control, or wetlands protection.” Two-thirds of the farmers surveyed were willing to pay part of the costs of protecting the environment as long as the general public also paid part.<sup>15</sup>

As reported in *Land Economics*, several professors conducted a study to identify and, if significant, to quantify the impact of large hog farms on property values in the surrounding area. They found that there is a significant effect on property values when a new hog operation is built. They found that the percentage change in property values depends on the distance of the farm from a house (greater distance=smaller change) and the amount of animal agriculture already in the area (less existing animal agriculture=bigger change.) For example, the predicted change in housing prices within 1/2 to 1 mile of a new hog operation ranged from -8.44 to -.29 percent depending on how many animals were already in the area. When a “middle” amount of animals already existed, the change was -4.75 percent.<sup>16</sup>

This may just sound like economic jargon. However, in Illinois, DeWitt County officials lowered assessments by 30 percent on houses within one and a half miles of a 7,400-sow farm. Homes within 2 miles had their assessments lowered by 10 percent.<sup>17</sup> If other counties follow this precedent, counties’ revenues will be adversely affected.

# How Governments Are Responding

*Mellie L. Warner*

## South Carolina's New Regulations

New standards for the permitting of swine and other agricultural animal facilities went into effect on June 26, 1998. The requirements for meeting the new standards are numerous.

Existing swine facilities are considered permitted unless expansion is proposed or a new waste utilization area is added. A swine facility must have a permit if its capacity exceeds 210 finishing hogs or 30,000 pounds of animal live weight at any one time. Swine facilities with less than 70 finishing hogs (10,000 pounds of animal live weight) do not have to get a permit, but are required to have a waste management plan that conforms to regulations. Facilities with 70 to 210 finishing hog capacity (10,000 to 30,000 pounds of animal live weight) are not required to have a permit, but must submit to DHEC and implement a waste management plan that meets the regulations. Ranged swine facilities are not required to have a permit if the size of the range area is sufficient to allow for natural degradation or utilization of the swine waste with no adverse impact to the environment. However, DHEC may require a permit of any facility after a site visit. DHEC approval must be sought for any change in ownership or control of a facility; an increase in the permitted number of swine; increase in the normal production animal live weight; addition of waste utilization areas; change in swine waste treatment, handling, or disposal; or change in method of dead swine disposal.

Permit application fees depend on the size of the proposed facility. Large swine facilities are defined as having more than 420,000 pounds of normal production live weight. The application fee for permitting a large swine facility is \$680. For a small swine facility (less than 420,000 pounds of normal production live weight,) the permit application fee is \$340. Swine facilities with less than 30,000 pounds of live weight are generally not required to have a permit, so no fee is required. Animal facilities other than for swine are charged permit fees according to type of manure handling system. Wet operations (lagoons, tanks, etc.) are charged \$240 and dry operations are charged \$165.

The new 1998 regulations also provide for annual environmental operating permit fees for agricultural facilities. Large swine facilities will pay \$300 per year and small facilities will pay \$150. Other animal facilities will pay \$150 for wet operations and \$75 for dry operations. Any facility with a valid permit on July 1 of a year will be subject to the fee for that state fiscal year.

Before DHEC will consider an application, it must receive a completed application form. Among the things that must be included are<sup>18</sup>

- a) facility capacity,
- b) concentration of constituents in swine waste (though for new facilities, waste analysis information from similar facilities or from published sources may be used until 6 months after the new facility starts operation),
- c) swine waste handling and application information,
- d) facility waste utilization area information, details of groundwater monitoring wells and plans,
- e) an odor abatement plan,
- f) a vector abatement plan,
- g) a dead swine disposal plan,
- h) a soil monitoring plan,
- i) plans and specifications for all other waste treatment or storage structures,
- j) notification forms from all owners whose boundaries are within 1,000 feet of the facility's property and a tax map identifying inhabited dwellings that must be notified,
- k) an emergency plan,
- l) waivers of setback distances (if any), and
- m) the proper fee.

A complete application package must be received by DHEC before a permit can be issued. DHEC may ask for additional information. DHEC will conduct a site inspection before a permit is issued. The cumulative effect on the environment will be considered and DHEC will act to prevent increased air or water pollution. Alternative waste treatment and disposal methods may be required in watersheds which are nutrient-sensitive waters.

Notification of intent to construct or expand a large swine facility must be made (costs are included in application fees). Notice will be published in a local newspaper of general circulation. Persons on adjoining property, the appropriate county commission, the appropriate waste supply district, and any person who asks to be notified must be notified by first-class United States mail or by hand delivery of the notice. The notice will include instructions for public review and comment and will allow for a minimum 30-day comment period. If there is sufficient interest, DHEC will conduct a public hearing (30 days notice required.) If a permit is issued, at least 20 days must be allowed for appeals before the permit can become effective. The swine facility lagoon or waste-storage pond can only be built when the permit is effective with no appeals pending. To begin operations, the operator must have the preparer of the Waste Management Plan certify:

- 1) that construction has been completed in accordance with the approved Waste Management Plan and the requirements of the regulations,
- 2) that no portion of the facility is located in the 100 year flood plain unless properly protected,
- 3) a plan for the containment of lagoon failures, and
- 4) the design of the lagoon lining.

A final inspection may be required. Swine permits will be valid for no more than 7 years. Other permits do not expire.

Required setbacks are part of both the Swine Law of 1996 and the 1998 regulations concerning other animal operations. Setbacks are specified for potable wells, ditches, property lines, and waters of the state. Setback distances vary with the kind of facility, the size of the facility, the type of liner materials in a lagoon or storage pond, and the classification of waters nearby. Other factors that should be considered in siting facilities include proximity to the 100-year flood plain, soil type, location in watershed, proximity to areas such as state or national parks and forests, proximity to other known point source discharges and potential nonpoint sources, slope of the land, and air drainage way.

Swine waste lagoons and waste storage ponds must not exceed 4 acres of surface area and must, at a minimum, be designed to NRCS Technical Guide specifications. Liners are required and must have a permeability rate of  $10^{-6}$  cm/sec or less. (Swine lagoons must have a combination of synthetic and natural liners; for others only natural liners are required.) If seepage has a negative impact on groundwater, the lagoon will be repaired at the owner's expense. Waste must be kept out of contact with groundwater. The minimum distance between the lowest point of the lagoon and the highest point of the underlying groundwater is 2 feet unless a commercial liner of at least 30 ml thickness has been properly installed. At least one up-gradient and two down-gradient monitoring wells are required at large swine facilities. DHEC may require monitoring wells for small operations. Monitoring wells must be permitted and sampled at least once a year. DHEC may visit routinely or randomly to sample wells. All underdrains must be removed from below the lagoon and surrounding area before a lagoon is constructed. Proper water levels must be maintained at all times. Any breach or other failure of a lagoon or waste pond must be reported immediately to DHEC, the appropriate local officials, and the owners or operators of any potable surface water treatment plant that could reasonably be expected to be adversely affected.

Regulations for waste utilization areas are designed to keep nutrients and other constituents of waste out of the water supply. Siting considerations are similar to those for lagoons including setbacks and other factors such as soil type, other sources of pollution, timing of waste application, type of vegetative cover, its nutrient uptake ability, and the timing of its harvest. Limits are placed on the amounts of nutrients and other constituents that may be applied to a given piece of land. Swine waste shall not be applied to land that is flooded, frozen, snow-covered, or saturated from recent precipitation or during inclement weather. Soils must be tested, equipment must be calibrated, and waste must be analyzed in accordance with the regulations. Groundwater monitoring may be required.

Spray irrigation systems must be designed for uniform application. Application rates should be based on the agronomic requirements of the crop. Conservation measures may be required to keep runoff from entering or leaving the waste utilization area.

Swine waste must be analyzed at least annually or when the feed composition is changed substantially. Dead swine must be disposed of in an approved manner as specified in the waste management plan.

DHEC may impose additional or more stringent requirements on a case-by-case basis as they determine the need. They may require the operator to investigate and remediate any adverse impact to the waters of the State. No waste can be released to the waters of the State unless it has been treated to drinking water quality. Swine medical waste cannot be disposed of in swine lagoons, waste storage ponds, or on land applied with swine waste.

Producers must use Best Management Practices to minimize odor problems. DHEC shall require remediation if it determines that an undesirable level of odor exists. Individuals or groups are not prohibited from lodging complaints against swine facilities.

Producers must keep good records including a copy of the approved Waste Management Plan, approved updates, and a copy of the permit(s). Records for each waste utilization area are to be developed and maintained including the amount of waste applied each time, sampling results of the waste, soil monitoring results, groundwater monitoring results, and cover crops grown. For the facility, records must be kept on monthly animal count and the normal production live weight and the mortality count and method of disposal. Records for the lagoon or waste storage pond must include monthly water levels and any groundwater monitoring results. Records must be kept for 8 years at an approved location. All records must be made available to DHEC during normal business hours on request.

All swine operations must submit the following to DHEC on an annual basis or more frequently if required: waste sampling results and the rolling average; soil monitoring results, if any; groundwater monitoring results, if any; calculated application rates for all waste utilization areas; and the adjusted application rates based on the most recent swine waste sampling and soil samples, as applicable. The application rate could also change due to a change in field use, crop grown, or other factors.

Operators of swine facilities, lagoons, waste storage ponds, or waste utilization areas must be certified under the program created by Clemson University. Failure to obtain certification (within 1 year of the effective date of the issued permit) will be considered a violation of the regulations.

Persons who violate these regulations or permits issued under these regulations are subject to criminal and civil penalties of the South Carolina Pollution Control Act.

Similar regulations apply for other animal species, also as of June 26, 1998. The application fees for non-swine animal agriculture are \$240 for farms using wet manure systems and \$165 for those with dry manure systems. The annual operating fees are \$150 for wet manure systems and \$75 for dry manure.

### **What the Federal Government Is Doing**

The Federal government has had the power to regulate nonpoint pollution sources such as animal agriculture under the Clean Water Act since 1973. However, it chose to focus initially on point source pollution such as that from factories and sewage systems. The Environmental Protection Agency (EPA) delegated much of its agricultural enforcement authority to the states (currently 43 states). Although the primary criterion for delegation was enforcement of at least minimal standards set forth in the Clean Water Act, the results have been accusations of lax enforcement in some states and wide variations in regulations across the country.

The Environmental Protection Agency brought the issue of nonpoint pollution into the spotlight last fall on the 25th anniversary of the passage of the Clean Water Act. Vice President Gore directed the EPA and the USDA to cooperate with each other and with other government agencies to come up with a plan that will assure clean water for all Americans.

In April 1998, the EPA and USDA jointly released the *Clean Water Action Plan: Restoring and Protecting America's Waters*.<sup>19</sup> No new legislative authority is required for the implementation of this plan; the existing legislation is sufficient. However, history tells us that Congress is likely to play a major role in shaping a new regulatory framework. The plan uses four key tools to build on the success of the last 25 years in order to further improve and protect the nation's waters.

The tool with the greatest impact on agriculture is titled **Strong Federal and State Standards**. The emphasis is on cooperation between the levels of government in order to address the remaining water quality problems in the United States. Some specific goals of this tool are to assure that fish and shellfish are safe to eat, to ensure safe beaches, to expand control of storm water runoff, to improve state and tribal enforceable authorities, to address polluted runoff, *to define nutrient reduction goals*, and *to reduce pollution from animal feeding operations*. The Clean Water Action Plan does not single out farmers. However, some very specific regulations are in store. According to proposed regulations issued in March 1998, permits will be required for all farms with more than 1,000 "animal units:" 1,000 cattle, 2,500 swine or 100,000 chickens. About 6,600 operations nationwide fit that criteria. Smaller operations will be required to have permits under some circumstances.

Another tool is the **Watershed Approach**. Looking at entire watersheds will encourage coordination between Federal, State, local, and tribal agencies along with the public. This should help to reduce or prevent pollution in the most efficient (and thus cost-effective) manner. **Natural Resource Stewardship** is the third tool. The Department of the Interior will spearhead the development of a Unified Federal Policy to protect water quality and aquatic systems on Federal lands. Federal land managers will work to improve water quality protection and to accelerate watershed cleanup. The loss of wetlands is to be reversed with a net increase of 100,000 acres per year by 2005 being the goal. The National Oceanic and Atmospheric Administration will take the lead in protecting coastal waters. Incentives will be provided for private landowners to reduce polluted runoff from agricultural, range, and forest lands along with expertise on how to accomplish this. By 2002, 2 million miles of conservation buffers are to be established. The fourth tool is **Information**. Informed citizens and officials are critical to watershed improvement. This should include information about existing water quality conditions and, also, information on how individuals can reduce water pollution.

On October 28, 1997, Senator Tom Harkin (D-Iowa) introduced S.1323, the Animal Agriculture Reform Act, "To regulate concentrated animal feeding operations for the protection of the environment and public health, and for other purposes." This act would put USDA in charge of regulating animal agriculture. It would require concentrated animal feeding operations to have approved, detailed waste management plans and to adhere to the plans. Some of the information required for such a plan are the location and size of the operation, the locations and names and addresses for adjoining properties, crop or cover crop information, plan for periodic nutrient testing of soil and animal waste, estimates of the amount of manure produced annually by each type of animal, description of management practices regarding application of waste and the prevention of soil loss, surface water pollution, ground water pollution and odors from animal waste, description of contingency measures, description of record keeping procedures, and any other requirements necessary to comply with this or other laws and regulation. Inspections would be required before a plan is approved to assure that the plan is adequate and after approval to assure compliance.

Under the bill, maximum levels for nitrogen, phosphorus, and other substances will be established. Aerial spraying will be restricted to minimize potential water pollution. Standards will be established for containment systems and their structures.<sup>20</sup> The bill was referred to the Committee on Agriculture on the day it was introduced. Hearings were held April 2, 1998. No amendments have been offered and no floor actions have been taken.

### **What's Happening in the States**

This section highlights a few current events around the country involving animal agriculture. These are selected examples from the press. Clemson University is participating in a national project to track the status of Confined Animal Feeding Operation (CAFO) regulations in each state.

**South Carolina.** In Elloree, an Orangeburg County town of 800, citizens are fighting a proposed 8,400-pig nursery facility. The town is worried that odors from the pig farm near Santee State Park will discourage tourists. Elloree is trying to fix up its downtown to attract tourists' business. The State Department of Parks, Recreation and



Tourism has also gone on record as opposing the farm. Officials are concerned over odors and the possibility of leakage or overflow from lagoons fouling creeks that flow through the state park. DHEC issued a permit for the farm, but construction must be delayed until the appeal is heard. The farm's owner says the use of the land for a swine farm is nothing new. In 1996, Orangeburg County produced 37,400 pigs.<sup>21</sup>

*Pfiesteria piscicida* is algae that can cause fish deaths. There is some evidence that elevated phosphorus levels in water can trigger a "bloom" of such algae and lead to oxygen depletion. Fish are affected by the low oxygen levels and by lesions caused by the algae. Although *Pfiesteria piscicida* exists in South Carolina, there have not been any fish kills associated with it. The Task Group on Toxic Algae has developed a plan to discover and contain possible outbreaks. Advisories have been prepared which can be released to warn fishermen and swimmers if necessary. Water monitoring is being stepped up and local agents are being trained to recognize early signs of *Pfiesteria*. Doctors will be trained to identify "Estuary Associated Syndrome," the symptoms of exposure to *Pfiesteria* outbreaks.<sup>22</sup>

**North Carolina.** The state is known for having welcomed corporate hog farming with open arms and then slammed the door when problems arose. The 2-year moratorium on new farms/permits remains in effect as regulations and the permitting process are debated. In the first quarter of 1998, state inspectors found 570 problems at livestock farms. Record rains increased the problems of high lagoon levels and limited the number of suitable days for field spraying. Tighter regulations meant more things were considered problems than before. But on the bright side, farmers were more likely to call regulators when they perceived a problem because they knew whom to call and because they felt they would be dealt with more leniently with respect to fines if they cooperated with the authorities. However, environmentalists argue that lagoons are a deficient technology that work only if there isn't much rain.

The moratorium is due to expire on March 1, 1999. However, there is a proposal in the NC House to extend the moratorium until October 1, 2000. Another proposal would extend it for 6 months, until Oct. 1, 1999. Some legislators are concerned that the current expiration date does not allow enough time to debate an extension of the moratorium when the legislature reconvenes in 1999.<sup>23</sup> Despite the existence of the moratorium, hog numbers in the state have continued to expand.

Researchers at North Carolina State University are investigating the increase in atmospheric ammonia levels in Sampson County. Viney Aneja of North Carolina State University says that hog barns and waste lagoons are the obvious source of nitrogen levels that have more than doubled in the last twenty years. The NC Division of Air Quality estimates that at least 186 tons of ammonia are discharged into the air daily by hog farms.<sup>24</sup>

**Maryland.** In April 1998, Maryland passed legislation to protect the Chesapeake Bay from pollutants associated with *Pfiesteria piscicida*.<sup>25</sup> Farm groups succeeded in softening the impact of the bill by winning delays in the implementation of the new regulations. Most farmers will be required to test their soil and have fertilizer use reduction plans by 2001, and all will by 2004. Limits on both nitrogen and phosphorus are included in the legislation.

In May 1998, Tyson Foods agreed to pay \$6 million in Federal fines and for improvements in waste disposal stemming from practices at a Hudson Foods plant that Tyson had recently purchased. In June, Maryland officials accused Tyson of continuing to dump thousands of gallons of waste daily from its Berlin chicken-processing plant onto a 105-acre farm near Ocean City.<sup>26</sup> Although state authorities had notified Tyson in April that the practice violated Maryland's environmental laws, the practice was not stopped until the *Washington Post* reported the story.<sup>27</sup> State and company officials met July 2 to discuss Tyson's waste disposal options and the possibility of imposing fines.<sup>28</sup>

Another Eastern Shore poultry farm, Allen Family Farms, is also accused of failure to meet environmental standards. The company is in the process of building a treatment plant.<sup>29</sup>

**Virginia.** This neighbor of Maryland whose rivers also pour into the Chesapeake Bay did not pass legislation to regulate animal agriculture in 1998. Although bills were proposed that would have regulated the industry or at least studied the problems, none of them passed.<sup>30</sup>

**Kentucky.** Kentucky passed emergency legislation to regulate hog farms in April, 1998.<sup>31</sup>

**Colorado.** Colorado has failed to pass state-wide regulations for large scale hog farms. Therefore, ranchers and farmers have joined with environmental groups in an attempt to put a ballot initiative on the November 1998, ballot. The initiative would require groundwater monitoring, deep-soil testing, coverage of lagoons, permits and inspections of waste disposal systems, and assurance of operators' ability to pay to correct environmental problems they might incur.<sup>32</sup> The initiative passed.

**Ohio.** The Ohio EPA has announced that it plans to increase public notification and involvement in the permitting process for large livestock facilities. Local media and state and local officials will be notified at several stages in the permitting process. Comment periods and the possibility of public hearings are included in the plans.<sup>33</sup> The EPA plan comes in the wake of complaints over the approval of a large addition at Buckeye Egg Farm for which there was little public notice given. Rep. Jay Hottinger has proposed legislation requiring notification of permit applications for large livestock enterprises. Citizens feel these are step in the right direction, but that the EPA needs to look again at manure hauling and spreading.<sup>34</sup>

**Oklahoma.** The Oklahoma House passed a 1-year moratorium on corporate hog facilities. However, the Senate repealed the moratorium effective August 1, 1998, while placing new restrictions on animal operations. The bill "Prohibits construction of any new or expanding swine facility requiring licensure until the Department of Agriculture issues a building permit; Provides various statewide setback requirements from the closest occupied residences, according to the size of the operation; Prohibits any licensed swine operation from locating within three miles of certain recreational sites or public drinking water supplies; Authorizes the Department of Agriculture to assess fees on licensed swine operations of 80¢ per animal unit capacity annually; Requires installation of leak detection systems or sufficient monitoring wells around each waste retention structure for the purpose of ensuring greater protection of the state's water supply; Requires waste education and training for all persons involved in the treatment, storage or application of waste from licensed facilities; and Requires licensed facilities to develop an Odor Abatement Plan to address methods for reducing odors caused by animal maintenance, waste storage and land application, and carcass disposal."<sup>35</sup>

Oklahoma is also interested in regional cooperation with other states but efforts to establish an interstate compact were unsuccessful.<sup>36</sup> Of particular interest are Missouri and Arkansas whose rivers feed into Oklahoma waters.<sup>37</sup>

### **What's Happening at the County and Local Levels**

The role that local and county governments are being allowed to play varies from state to state. Some states are ruling that local opinions must be considered in permitting decisions. Other states have ruled that counties cannot regulate agriculture by zoning or other means. One danger of local permitting regulations is that they may be more politically motivated and subject to favoritism. On the other hand, it seems hard to deny a say to the people who will be most affected by a large animal operation.

There have been some attempts by local or county governments to regulate animal agriculture. In August 1997, the Attorney General of Kentucky issued an opinion that local governments can regulate industrial-scale hog operations by zoning or other means.<sup>38</sup> Last year in Missouri, environmentalists proposed legislation that would require public hearings on new, large farms and would require a county board's approval. It was given little or no chance of passage in that session of the legislature.<sup>39</sup> In March 1998, the Iowa Supreme Court overturned local ordinances restricting pig farms in Humboldt County finding that they conflicted with state laws.<sup>40</sup> In Tulare County, California, county officials are encouraging new dairies to locate in areas where the groundwater is deep (sometimes more than 100 feet below the surface.) The county authorities limit the number of cows per acre if two or more dairies are within a mile radius of each other in order to prevent clustering.<sup>41</sup>

In Florida, Regional Water Management Districts play a major role. First in the Lake Okeechobee area, now in the Suwanee River drainage area, these agencies are a major factor in permitting new operations and regulating existing ones.

South Carolina's new regulations were sparked in no small measure by the home rule issue. Local government interests sided solidly with environmental groups in the debate over new legislation.

# The Changing Structure of Animal Agriculture

*Mellie L. Warner*

Animal agriculture is becoming less competitive in the economist's sense of the word. The number of firms (farms) is declining and market power is being concentrated more and more in the hands of integrators/contractors. In a perfectly competitive market, both the buyers and the sellers are price takers. The large number of buyers and sellers guarantees that market power is evenly distributed. But now the structure of agricultural markets is changing. Some even believe that we are about to plunge into a new revolution in agriculture where vertical integration will be the norm and the number of independent firms will be few. (See the slides for Steve Baker's Clemson talk at <http://hubcap.clemson.edu/scafrrs/seminar.html>.)

## I. The Poultry Industry<sup>42</sup>

The poultry industry has become almost totally vertically integrated starting in the 1960's. Several factors have contributed to this. First, because of the relatively short reproductive cycle of chickens (5 months), biological changes such as genetic changes can be made fairly rapidly. The genetic base of poultry is narrow. This helps to reduce management costs and also helps to ensure uniform products for processors and consumers. The two stages of poultry production (hatching and growing) mean fewer stages of production than for livestock. Poultry enterprises tend to be large and specialized.

Some poultry firms have been successful at developing branded products for consumers. They have also innovated new product lines with greater value added. Chicken products have been enthusiastically welcomed by consumers whether at fast food chains, in the grocery freezer, or just as skinless/boneless breasts in the meat case.

The organization of the poultry subsector ensures that capital requirements are shared between the integrator and the contract grower. (The grower provides the land, buildings, and equipment. The integrator owns the feed, the birds, and everything else.) This shifts some risk to the grower. But overall, risk to the grower is limited as is the potential for larger than normal profits.

Little additional integration is expected in the poultry industry because of the high level of integration already existing.

### Broiler and Other Meat-Type Chicken

Percent of Sales by Number of Chickens Sold per Farm.

Year	1-29,999	30,000-99,999	100,000-199,999	200,000-499,999	500,000+
1992	.18	3.21	12.73	48.35	35.53
1987	.32	6.68	21.3	47.38	24.31
1982	.47	10.39	28.77	44.63	15.74
1978	.86	17.22	35.62	34.43	11.87
1974	1.73	28.26	70.00 <sup>43</sup>		

## II. The Hog Industry

The pork industry is following the lead of the poultry industry with respect to vertical integration. The genetic base is narrowing and the biological cycle, while longer than for poultry, is still short enough (12 months) to allow for fairly rapid genetic changes to improve quality and consistency of products. Integrators are building on the tradition of branded processed products such as bacon, ham, and sausage, but have not had the success of the poultry companies in introducing new, high value-added products especially with respect to the fast food industry. Hog operations have increased their sizes and their degrees of specialization. Although large "farrow-to-finish" opera-

tions still exist and there are also two-stage setups, the trend is to have three stages: farrow, nursery, and grow-out (finish). This tends to increase transactions costs, but efficiency gains more than offset them.

As in the poultry industry, the integrator and the contract grower share the capital requirements and the risk. Growers supply the land, buildings, and equipment while the integrators retain ownership of the animals and feed. Growers receive a reasonable return on their investments, but give up the potential for large profits (and losses) from swings in hog and feed prices. Vertical integration in the hog industry is likely to continue to grow.<sup>44</sup>

Writing for the National Pork Producer’s Council, Dennis DiPietre of University of Missouri—Columbia<sup>45</sup> finds that agriculture is subject to the same evolution from labor-based production to knowledge-based production that the rest of the economy has been experiencing.

DePietre defines three paradigms of pork production:

- **The Pig Producer**—swine production is a way to use labor during the crop “off season.” Grains can be fed to the pigs when grain prices are low. Characteristics are labor-intensive production with little management.
- **Meat Producers**—lean meat is produced efficiently and at low cost. Record keeping and other intensive management practices abound. Pork production is separated from crop production. The ability to produce quality for specialized export markets may be affected.
- **Food Producers**—this post-industrial paradigm is just beginning to emerge. The focus is on the food that hits the plate. Differentiated pork products with multiple quality characteristics will be emphasized. Management/knowledge and capital requirements are great while labor requirements are relatively small. However, most management comes from above. The integrators provide the decision-making while the growers “push buttons.”

The evolution of pork production through these paradigms will also contribute to the movement away from a competitive market as products become more differentiated. Vertical and horizontal integration will also play a major role.

**Hogs and Pigs, Percent of Inventory by Size Group, U.S.**

Year	1-99 head	100-499 head	500-999 head	1000-1999 head	2000-4999 head	5000+ head
1997	3.0	12.0	14.0	16.0	20.0	35.0
1992	5.5	25.5	22.0	19.0	28 <sup>46</sup>	
1987	7.16	32.07	22.81	16.97	12.88	8.11
1982	9.18	36.35	23.68	16.04	9.81	4.94
1978	13.78	43.28	20.25	12.33	6.92	3.41

**III. The Beef Cattle Industry**

The beef cattle industry does not lend itself to vertical integration as well as the poultry and pork industries. The biological cycle is longer (24 months) and the genetic base is broad, so genetic modifications to improve quality and achieve uniform products are more difficult and time-consuming. There are three production stages (cow-calf, stocker, and feeding) which increase transactions costs and capital requirements. The large rangeland or pasture requirements of cow-calf operations also have slowed integration in this sector. Beef is still marketed mainly as a commodity and efforts to introduce new, branded products have mostly failed.<sup>47</sup>

However, the cattle-feeding and meat-packing industries have also participated in the trend toward larger and fewer firms. From 1972 to 1995, the number of feedlots in the 13 main cattle-feeding states declined from 104,340 to 41,365 while the average marketings per feedlot increased from 2,287 head to 5,648 head. Even more striking is the fact that in 1995 the largest 1,936 feedlots averaged 10,897 head while the rest averaged only 58 head.<sup>48</sup>

Meat packing is a highly concentrated industry with the top four firms accounting for an estimated 80 percent of United States steer and heifer slaughter in 1996. Firms have grown in order to take advantage of lower average costs associated with larger plant sizes. Economists have been studying whether concentration in meat packing has led to lower prices for inputs (fed cattle) and higher prices for outputs (wholesale meat). So far, the effects found have been small. Efficiency gains may have been enough to offset the price changes found.<sup>49</sup>

Most of the trend toward concentration in the beef cattle market has been horizontal (fewer, larger firms in each stage of production.) However, there are instances of vertical integration such as packer ownership of cattle, contracting into the stocker stage and retained ownership of cattle into the feedlot.

**Beef Cows, Percent of Inventory by Size Group, U.S.**

Year	1-49 head	50-99 head	100-499 head	500+ head
1997	30.3	19.5	36.2	14
1992	32.6	19.6	47.8 <sup>50</sup>	
1987	23.21	12.9	34.3	29.59
1982	24.49	13.01	34.06	28.44

**Cattle and Calves, Percent of Inventory by Size Group, U.S.**

Year	1-49 head	50-99 head	100-499 head	500-999 head	1000+ head
1997	12.4	13.8	38.5	11.4	23.9
1992	14	14.1	38.7	33.2 <sup>51</sup>	
1987	14.93	15.04	38.21	10.31	21.52
1982	15.74	16.04	38.83	9.98	19.41
1978	16.36	16.7	37.27	9.71	19.95

**IV. The Dairy Industry**

The dairy cattle industry has followed a pattern of fewer farms with cows and fewer overall cows while the average number of cows per farm has grown along with total and per-cow milk production. Dairy cooperatives market most of the bulk milk produced on America's dairy farms. In 1993 and 1994, coops delivered 86 percent of the total milk delivered to plants and handlers. The number of coops has decreased over the years while their size has grown. Bargaining-only cooperatives act as middlemen to negotiate prices between farmers and processors. Manufacturing/processing coops process the raw milk into dairy products such as butter and cheese.<sup>52</sup>

For decades, government programs eliminated the risk of very low milk prices for producers. A phase-down of price supports in the 1980's has led to extreme price volatility. Price supports are due to expire by 2000. Larger and fewer cooperatives, due in part to mergers, may result in increased bargaining power. Many observers feel that vertical integration will also increase as a result of more volatile prices and possible changes in the Federal milk marketing order system.

**Milk Cows, Percent of Inventory by Size Group, U.S.**

Year	1-29 head	30-49 head	50-99 head	100-199 head	200+ head
1997	3.5	11.5	26	20	39
1994	4.6	14	28.7	19.3	33.4
1991	6.3	16.6	31.7	45.4 <sup>53</sup>	

# Problems and Solutions

*Mellie L. Warner*

## What Can Be Done?<sup>54</sup>

### *Historical Context*

The problems arising from the growth in concentrated animal agriculture are not unique when considered in historical context. Over the years problems have arisen and solutions to the problems have followed. For example, in the 1930's the problem was loss of topsoil to erosion by wind and water. The Soil Conservation Service was formed to find solutions to the problem. As a result of improved farming techniques, erosion is much less of a problem. This is typical. Changes in agriculture lead to problems, and then solutions are found. Private and public researchers are working hard to find the answers. The next problem to be considered will likely be air pollution (not just odor) caused by the volatilization of chemicals in manure. Researchers are already tackling this problem. Anticipation of problems can help reduce the lag between the perception of the problem and the finding of solutions. There is also a lag between finding the solutions and implementing them.

Farmers may feel that they are being singled out for environmental scrutiny. Industry probably felt the same way 25 years ago. The combination of reduced industrial pollution and increased concentration of animal agriculture has pushed agriculture into the spotlight. As progress in cleaning up agriculture is being made, other sources of nonpoint pollution such as septic tanks and pet wastes are also coming to the forefront. It may be that household pollution is the next big thrust in environmental improvement. But in striving to clean up the planet, all sectors will be held responsible. Those that do not cooperate voluntarily will likely find themselves forced to comply with growing regulations.

The problems of nonpoint pollution from agriculture do not lend themselves to a “one size fits all” solution. Regulators should keep in mind that flexibility is important if goals are to be reached at the least possible cost to farmers and society. Individual farmers may be able to use several incremental changes to reach an overall solution to their particular problems.

### *Possible Solutions—Good Neighbors*

Being a good neighbor is important. Willingness to work with neighbors to avoid problems to consider new solutions will lessen the likelihood of resistance. Everyone resents being presented with a “fait accompli” when it has a major impact on them. Consideration in the timing of manure application and keeping neighbors informed of plans will help to avoid problems.

Site selection is the first key to successful animal agriculture which doesn't pollute and doesn't offend the neighbors. Factors relating to odor control are *prevailing wind direction*, *separation distance*, and *farmstead visibility and condition*. Separation distances are included in state regulations. Use of visual barriers such as trees can reduce odor as well as reducing the perception of odor.<sup>55</sup>

Odor control is a major concern, but the migration of odor off the farm is not the inevitable result of animal agriculture. Being a good manager and a good neighbor can eliminate or reduce odor problems. Keeping hogs and hog barns clean and dry will help. Spilled or moldy feed should be cleaned up and dust should be kept to a minimum. Chemical and biological agents have been tried for odor control, but are not very effective. High efficiency particle air filters can keep odors from reaching the air outside of animal buildings.

Lagoons can be another source of odors. Lagoon loading should take place on a regular schedule, at least weekly or even daily. Add hydrated lime or caustic soda if the pH level falls below 6.7. Never allow a lagoon to overflow. Consider a cover. Covers can be expensive, but as concerns over odor grow they may be worthwhile. Just floating straw on the top has been shown to reduce odors by 50 percent or more. It may be possible to get lagoons to

crust over by changing feed rations. Tree windbreaks can break up the odor plume and even remove particulate matter.

Land application of manure is a major source of odor complaints. Lower gun pressure can increase droplet size and reduce odors. Injection below the soil surface is the best way to reduce odor. Applying manure early in the morning or on cloudy days helps. Be considerate of neighbors by applying manure when the winds are blowing away from them. Weekday applications are more likely to find the neighbors away from home. Check to make sure the neighbors aren't planning outdoor activities, especially around holidays.<sup>56</sup>

### *Possible Solutions—New Technologies*

Researchers are attacking the problems of too many nutrients from animal waste reaching improper places from many angles. Below are a few areas that have been in the news in the last several months.

New corn technology from the USDA can cut the amount of phosphorous in manure in half. The new hybrids will be available in 2000. Genetic engineering may produce animals that use nutrients more efficiently reducing costs as well as the amount of waste.<sup>57, 58</sup>

Diversa Corp. of San Diego announced on May 18, 1998, that it has found an enzyme that both increases the amount of nutrients in grain that animals can use and reduces the amounts of nutrients (especially phosphorous) that end up in manure. As a feed additive, the phytase will reduce the costs of feeding animals and the cost of proper disposal of wastes. Tests have been conducted on both poultry and swine.<sup>59</sup>

Researchers at Michigan Tech University are looking into the possibilities of using animal waste as part of a de-icing mixture that could replace road salt and eliminate the resulting corrosion of cars.<sup>60</sup> And UPI reported in September 1997, that officials in Harbor Springs, Michigan, were considering turning sewage into snow using equipment borrowed from ski resorts. They claim that the cold kills bacteria and that when the snow melts in the spring the waste is gone. (But the nutrients are still somewhere.)<sup>61</sup>

Constructed wetlands are under investigation as water purification systems. An experimental wetland has been set up at Purdue University's Baker Animal Science Farm near Lafayette, Indiana. "The purpose of this study is to evaluate whether unlined constructed wetlands are a practical alternative for animal waste management in Indiana."<sup>62</sup>

In North Carolina, Sustainable Strategies is touting the use of bamboo forests to treat manure. Bamboo uses vast amounts of nitrogen in the production of protein. It can be used for building and construction materials, animal fodder, paper, fuel, and even food (bamboo shoots).<sup>63</sup> Clemson University is conducting experiments involving application of swine waste to pine forests.

High tech solutions are available from various companies. These systems concentrate nutrients and kill pathogens, producing a humus-like material that can be used as a soil enhancer.

Again, there is not likely to be one solution that works and is economically feasible for all situations. But progress is being made on many fronts and solutions will be found. The nutrients in manure are part of a closed system and will not disappear as if by magic. However, properly utilized, they can reduce the need to use chemical fertilizers which are outside additions to the system. A University of Minnesota soil scientist found that using hog slurry as fertilizer increased yields above those obtained with commercial nitrogen fertilizer in field trials.<sup>64</sup>

### **Good News**

In October 1997, the National Pork Producers Council announced their 1997 Environmental Stewards awards. All of the farmers who received the awards share a sense of duty to the environment. They are all proactive in their relations with their neighbors, demonstrating the benefits of sharing information and being open with neighbors.<sup>65</sup>



One farm was selected from each of five regions in the country on the basis of manure management system, financial management, farm aesthetics/neighbor relations, wildlife management, and innovations. A farm in Ohio uses tons of local “wastepaper” as bedding. The shredded paper stays out of landfills and reduces odor. They also recycle stale bakery goods into feed for their animals.

An Arkansas farm pipes waste mixed with fresh water to fields over a mile away. The farmers participate in a wood duck box project and maintain old canals for quail, bullfrogs, fish, and turtles. They recycle products from a dairy operation in a liquid whey system for feed.

A California farm recovers methane from a covered lagoon. This removes nitrogen from the manure and keeps it from getting into the air and water. By burning the methane they produce about \$85,000 worth of electricity each year. They also recover heat from the generators to heat their weaner pig nurseries during the winter. In the process, odor is reduced by 90 percent, dust is eliminated, flies are controlled, and water to irrigate and fertilize crops is provided.

In Iowa, a farm’s use of an exploratory trench around lagoons to prevent problems with abandoned drainage tiles has been adopted as a protocol for all lagoons by the Iowa Department of Natural Resources. The farm has clay-lined (24 inches) lagoons with plastic liner skirts around the tops to prevent wave erosion of the berms. Lagoons are surveyed at least twice a week.

A Pennsylvania farmer has installed manure leak detection systems at all his new facilities. He works with the feed mill to maximize feed efficiency and reduce waste.

Again, all of these farms are dedicated to environmental stewardship and good neighbor relations.

Another good news report came in March 1998 from the American Farm Bureau Federation. This year’s survey of (296) young farmers, age 18-35, found high levels of optimism about the future of farming. They thought that government regulations were their biggest challenge (26.5 percent), but about 93 percent said they select farming practices based on both the environment and economics.<sup>66</sup>

### **Bad News**

It’s not often that farmers go to jail for not handling manure properly, but it can happen. Two Henderson County, NC, dairy farmers were imprisoned in November 1997 for failing to comply with a court order to install a new animal waste treatment system. After seven years of dumping waste into Mud Creek, James Sexton, Jr., and Charles E. Sexton were cited for contempt of court when they failed to follow the court order issued in September 1996. The farm was ordered shut in September 1997 and the cows were removed.<sup>67</sup>

Reuters reported on May 8, 1998, that Tyson Foods will have to pay \$6 million for pollution caused by its newly acquired subsidiary, Hudson Foods. In addition to the \$4 million civil fine that Tyson will have to pay, it will also have to spend \$2 million to prevent further leakage of waste into the waters of Maryland, Virginia, Delaware, and Pennsylvania.<sup>68</sup>

# Other Sources of Nonpoint Pollution

*Mellie L. Warner*

Animal agriculture is not the only source of “non-industrial” water pollution. Crop and other plant agriculture can also have a significant, negative impact on water quality. And there are significant nonpoint sources of pollution that have nothing to do with commercial agriculture, especially waste water treatment systems, home septic tanks, and urban stormwater runoff.

Recent newspaper articles have reported the impacts of some of these enterprises. On May 9, 1998, the *Washington Post* reported that a 1,400-acre nursery and composting facility in Loudon County, Virginia, has “violated environmental laws and polluted a nearby stream, killing fish and other aquatic life.” Runoff from the piles of composting yard waste has turned the nearby stream an oily black. Neighbors have been complaining about odors for years. A lack of sensitivity and knowledge is demonstrated by a quote from Keith H. Stewart, CEO of the operation who said, “We’re talking about natural products decomposing. It’s not like we’re talking about chemicals.”<sup>69</sup>

In February 1997, *US Water News Online* reported on a study by the USGS which found that fertilizers were the largest source of nitrogen in the White River watershed of Indiana, accounting for 61 percent of the total input of nitrogen. Farm animal wastes accounted for 19 percent, rainfall for 17 percent, and municipal sewage-treatment plants and industrial discharges for 3 percent.<sup>70</sup>

The November 9, 1997 edition of *Florida Today* reported growing concern over leaking septic tanks around the Indian River Lagoon. Rapid development has caused an increase in the number and density of septic tanks. A high groundwater table and sandy, porous soil contribute to the problem of waste reaching groundwater and then surface water before sufficient decomposition has taken place. *Florida Today* reports that septic tanks have been linked to pollution in such widely dispersed areas as Puget Sound, Chesapeake Bay, and Sarasota Bay.<sup>71</sup> A study of Lake Weatherford in Texas that was reported in *Toxicological and Environmental Chemistry* found that both septic tanks and agriculture were sources of contamination.<sup>72</sup>

According to the South Carolina Department of Health and Environmental Control, South Carolina has over 700,000 septic tanks. In addition, there are over 200 human waste lagoons. These add to the potential for water pollution. Also, human sewage systems are known to incur spills and overflows.

The County of Los Angeles issued a press release on May 4, 1998, outlining the problem of pet waste which is washed by rain into streets and gutters and then into storm drains, only to end up **untreated** in the ocean.<sup>73</sup> The impact of 125,000 dogs leaving waste behind them should not be taken lightly. In Encino, California, June 6, 1998, was marked as a day for pets to “sign” a petition stating that they value the environment and will make sure their owners clean up after them.<sup>74</sup> On June 8, 1998, the *Washington Post* reported that pollution in Four Mile Run which meanders through Northern Virginia is likely due to dog waste left in parks and yards. Don Waye, senior water resources planner with the Northern Virginia planning commission and George M. Simmons of Virginia Tech have applied for a state grant to investigate the pollution genetically.<sup>75</sup>

Simmons has developed DNA fingerprinting techniques to identify the sources of fecal coliform.<sup>76</sup> In a study of pollution in a clam bed on Virginia’s Eastern Shore, Simmons found the sources to be deer and raccoons. When large numbers of these and other animals were removed from the area, “fecal coliform ... decreased by one to two orders of magnitude.”<sup>77</sup> (The number of deer in South Carolina is currently at least 1.6 million. Before restocking that began in 1954, the number of deer in South Carolina was about 10,000.)

Other urban pollutants that end up in stormwater include litter, debris, motor oil, fertilizers, and pesticides.

Keith Eshelman, a hydrologist at the University of Maryland center for Environmental Science, is studying the impact of forest defoliation by gypsy moths on the nitrogen content of runoff from the forests. He also thinks that over-browsing by deer could increase nitrogen runoff.<sup>78</sup>

The *San Diego Union-Tribune* reported on May 18, 1998, that the city of Thousand Oaks, California, has been fined \$2.1 million for a sewage spill that occurred when El Nino rains caused a wash-out of a sewer main.<sup>79</sup>

Florida's Broward County is threatening to fine the city of Fort Lauderdale up to \$15,000 per day if it does not enforce a city law that requires live-aboard boats to be hooked up to a city sewer line.<sup>80</sup>

All of these stories point to the fact that agriculture (particularly animal agriculture) is not the only source of water quality impairment. However, agriculture must not shirk its duty to control the amount of pollution it adds to the mix. All sectors of society must do their part.

# Sources of Funding for Farmers

[http://www.epa.gov/earth1r6/6wq/at/nps/f\\_source.htm](http://www.epa.gov/earth1r6/6wq/at/nps/f_source.htm)

There are several Federal programs designed to help farmers finance improvements in waste management. USEPA and USDA each offer programs and the two together offer joint programs.

## USEPA Funding Sources

*§319 Clean Water Act, Nonpoint Source Grant Program* - This is a State-operated water quality improvement program. States are required to develop an Assessment Report (identification of the water quality problems) and a Management Program (the strategy). The grant program is intended to implement the milestones of the Management Program such that water quality problems identified in the Assessment Report are addressed and water bodies are returned to their designated uses. State Nonpoint Source Programs can take many forms and use a combination of local projects and statewide efforts and programs to implement solutions. If you have a water quality problem in your area you are interested in working on, first contact your State Nonpoint Source Agency to discuss your idea and learn more about their particular funding cycle and current priorities. While developing a project proposal, consider the Watershed Approach, leveraging of funds and the abilities of various partners, cost effectiveness, and how well the project really addresses the root cause of the water quality problem. For more information on the Nonpoint Source Program, see the national Nonpoint Source Pollution Control Program website, at [www.epa.gov/owow/NPS/](http://www.epa.gov/owow/NPS/).

*The Clean Water State Revolving Fund Program* - Under this program, EPA provides grants or “seed money” to all states to capitalize state loan funds. The states, in turn, make loans to communities, individuals, and others for high-priority water-quality activities. As money is paid back into the revolving fund, new loans are made to other recipients that need help in maintaining water quality. While traditionally used to build or improve wastewater treatment plants, loans are also used increasingly for: agricultural, rural, and urban runoff control; estuary improvement projects; wet weather flow control; and alternative treatment technologies. Financial Assistance (<http://www.epa.gov/OWM>)

*The Hardship Grants Program for Rural Communities* - This grant program is designed to help small, disadvantaged rural communities address their wastewater needs. The Hardship Grants Program is designed to complement the Clean Water State Revolving Fund Program, which allows states to make loans to communities and individuals for high-priority water-quality projects. Financial Assistance (<http://www.epa.gov/OWM>)

*EPA/NASA Joint Program on Ecosystem Restoration* - Seeks research proposals to address fundamental concepts of ecosystem rehabilitation in the context of the larger watershed. This competition emphasizes fundamental research on important scientific principles related to watershed rehabilitation. National Center for Environmental Research and Quality Assurance (NCERQA)

*Environmental Education (EE)* - The purpose of the Environmental Education grants is to provide financial support for projects which design, demonstrate, or disseminate environmental education practices, methods, or techniques. Eligible applicants include local, tribal, or state education agencies; colleges and universities; nonprofit organizations; state environmental agencies; and non-commercial educational broadcasting agencies. Award amounts are up to \$25,000 regionally and \$25,000 to \$250,000 nationally. There is a non-Federal government match required of 25 percent. The approximate application due date is December/January each year with selections announced each summer. Applicants must demonstrate how the proposed project is new or significantly improved, has the potential for wide application, and addresses a high priority environmental issue. Projects MUST focus on one of the following: improving environmental education teaching skills; educating teachers, students, or the public about human health problems; building state, local, or tribal government capacity to develop environmental education programs; educating community through community-based organization; or educating the general public through print, film, broadcast, or other media. Contact nearest EPA Regional Office.

*Environmental Justice (EJ)* - The purpose of the Environmental Justice grants is to provide financial assistance to eligible community groups and Federally recognized tribal governments that are working on or plan to carry out

projects to address environmental justice issues. Eligible applicants include any affected community group, non-profit organization, university, or tribal government. Award amounts are up to \$20,000 granted. There is no Federal government match required. The approximate application due date is February each year with selections announced each June. Applicants must demonstrate how the proposed project will improve the environmental quality of the community by: having wide application or addressing a high priority issue; enhancing skills in addressing EJ issues and problems; establishing or expanding information systems for communities; facilitating communication, information exchange, and community partnerships; motivating the public to be more conscious of EJ issues; or leading to action to address those issues. Environmental Justice Information (<http://es.inel.gov/program/initiative/justice/ej-fs2.html>)

*EPA Research Grants* - Available in 1997 for topics including: Exploratory Research; Ecosystem Indicators; Issues in Human Health Risk Assessment; Endocrine Disruptors; Ambient Air Quality; Health Effects and Exposures to Particulate Matter and Associated Air Pollutants; Drinking Water; and Contaminated Sediment. The list might differ from year to year. Information, forms, etc. may be obtained by consulting the appropriate EPA Web Page. National Center for Environmental Research and Quality Assurance (NCERQA)

## USDA Funding Sources

Natural Resources Conservation Service (NRCS)

*Environmental Quality Incentives Program (EQIP)* - The EQIP provides cost sharing funds for landusers to implement conservation practices on their operating units. The program requires funds to be spent implementing practices prescribed in an approved conservation plan on land located in high priority targeted watersheds. Contracts for funding implementation of practices will be developed for 5 to 10 years. Contact your local NRCS office to apply. EQIP Fact Sheet—1996 Farm Bill Conservation Provisions, NRCS

*Wetland Reserve Program (WRP)* - The WRP provides funds for agricultural producers to enroll acreage into 30-year and permanent easements for wetland restoration. It provides 75 to 100 percent cost sharing for permanent easements, 50 to 75 percent cost sharing for 30-year easements, and 50 to 75 percent for restoration cost share agreements to help pay for the restorations. Contact your local NRCS office to apply. Wetlands Reserve Program Q&A—1996 Farm Bill Conservation Provisions, NRCS

*Wildlife Habitat Incentives Program (WHIP)* - This new program will help landowners improve wildlife habitat on private lands by cost sharing the development of habitat for upland wildlife, wetland wildlife, endangered species, fisheries, and other wildlife. Contact your local NRCS office to apply. WHIP Fact Sheet—1996 Farm Bill Conservation Provisions, NRCS

*Emergency Watershed Protection Program Floodplain Easements* - This program authorizes the Federal government to purchase floodplain easements. Contact your local NRCS office to apply.

*Forestry Incentives Program (FIP)* - FIP provides cost sharing funds for implementing practices that develop or restore forested lands according to an approved forest management plan. Contact your local NRCS office to apply. Forestry Incentives Program (FIP) Fact Sheet—1996 Farm Bill Conservation Provisions, NRCS

Farm Services Agency (FSA): ([FSA Homepage](#))

*Conservation Reserve Program (CRP)* - The CRP protects highly erodible and environmentally sensitive lands by enrolling the land into CRP contracts which pay the landowner to plant the land in grass, trees, or other acceptable permanent cover and keep it in that long-term cover for 10 years or more. USDA, Farm Service Agency, CRP Information

Cooperative State Research, Education, and Extension Service (CSREES): Fund For Rural America (<http://www.reeusda.gov/fra/>)

*Fund for Rural America Program* - The Federal Agriculture Improvement and Reform Act of 1996 established an account in the Treasury of the United States to provide funds for rural development programs and a competitive grant program to support research, education, and extension activities. To obtain program application materials, please contact the Proposal Services Unit, Grants Management Branch; Office of Extramural Programs; USDA/CSREES at (202) 401-5048. These materials may also be requested via Internet by sending a message with your name, mailing address (not e-mail), and phone number to [psb@reeusda.gov](mailto:psb@reeusda.gov) which states that you want a copy of the application materials for the Fund Program. The materials will then be mailed to you (not e-mailed) as quickly as possible. Fund For Rural America (<http://www.reeusda.gov/fra/>)

### **USDA and EPA Joint Funding Sources**

*Agriculture in Concert with the Environment (ACE)* - The primary purpose of this grant program is to promote the adoption of sustainable agriculture practices and reduce the use of highly toxic herbicides and other pesticides. Establishing a harmonious relationship between agriculture and the environment offers the opportunity for multiple gains on all sides—for the farm owner, farm workers, consumers, and communities as a whole. For more information or application forms, contact your regional host institution as listed on the Internet web site shown. Agriculture in Concert with the Environment (ACE) <http://es.inel.gov/new/funding/ace/ace.html>

*Sustainable Agriculture Research and Education Program (SAREP)* - This grant program is to fund research that will lead to reduced environmental stress from agricultural practices. Important research in pursuit of this goal includes: 1) Studies on the development and adoption of environmental-friendly farming practices and systems and 2) Studies that identify, evaluate, and interpret indications of agroecosystem health. For more information or application forms, contact your regional host institution as listed on the Internet web site shown. RFP: Southern Region Sustainable Agriculture Research and Education -Due 9/3/96 (<http://pprc.pnl.gov/pprc/rfp/archives/sare96s.html>)

# Websites of Interest for Agriculture and the Environment

Consider these websites as places to begin. Once you start exploring the internet, you'll find more places. Be sure to bookmark the ones you like, because sometimes it's hard to remember how you got somewhere. Be sure to check back with sites from time to time to see if they have been updated or new features have been added. Happy surfing!

## Federal Government

1. Ag Center Home Page—Office of Enforcement and Compliance Assurance-EPA (<http://es.epa.gov/oeca/ag/>). National Agriculture Compliance Assistance Center. “Your Source for Agricultural Environmental Compliance Assistance and Information.” “The U.S. Environmental Protection Agency (EPA), with the support of the Department of Agriculture (USDA), has developed a National Agriculture Compliance Assistance Center (Ag Center) to provide a base for ‘first-stop shopping’ for the agriculture community—one place for the development of comprehensive, easy-to-understand information about approaches to compliance that are both environmentally protective and agriculturally sound.”
2. List of funding sources for pollution prevention. [http://www.epa.gov/earth1r6/6wq/at/nps/f\\_source.htm](http://www.epa.gov/earth1r6/6wq/at/nps/f_source.htm). USDA programs are described at <http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/MiscFB.html>
3. Strategy for Addressing Environmental and Public Health Impacts from Animal Feeding Operations—Draft. March 4, 1998. USEPA draft AFO strategy. (<http://www.agriculture.com/contents/FFA/agman/>)
4. Compliance Assurance Implementation Plan For Concentrated Animal Feeding Operations (<http://es.epa.gov/oeca/strategy.html>) Draft proposal from EPA, March 5, 1998.
5. What's New at EPA. Links to new programs and publications at EPA. (<http://www.epa.gov/epahome/WhatsNew.html>)
6. Pollution Prevention News, EPA newsletter. What other people are doing. (<http://www.epa.gov/opptintr/ChemLibPPN/>)
7. Nonpoint Pollution Control Program—Office of Water—EPA (<http://www.epa.gov/OWOW/NPS/index.html>)
8. Agricultural Branch of EPA's Office of Enforcement and Compliance Assurance (<http://es.epa.gov/oeca/agbranch.html>) Includes *Enforceable State Mechanisms for the Control of Nonpoint Source Water Pollution* at <http://www.epa.gov/OWOW/NPS/elistudy/> which summarizes the laws under which states may regulate nonpoint source water pollution.
9. Clean Water Initiative: Restoring and Protecting America's Waters. EPA's Cleanwater Action Plan and resources. <http://www.epa.gov/cleanwater/>
10. Watershed Academy 2000, EPA. Distance learning. (<http://www.epa.gov/OWOW/watershed/wacademy/acad2000.html>)
11. Surf Your Watershed, South Carolina—information on watershed quality from EPA (<http://www.epa.gov/surf/stinfo/SC/>). Click on State Index of Watershed Indicators to see the watersheds in South Carolina in color indicating water quality. To get more information on a specific watershed, click on the map or scroll down to see a list of watersheds and then click.
12. Watershed advocacy groups in South Carolina. Part of Surf Your Watershed. (<http://yosemite.epa.gov/water/adopt.nsf/by+state?SearchView&Query=South+Carolina>)
13. EPA's Office of Wastewater Management. Links to various documents concerning wastewater. (<http://>



[www.epa.gov/owm/new.htm](http://www.epa.gov/owm/new.htm)) See especially <http://www.epa.gov/owm/afo.htm> for information on animal feeding operations.

14. Committee on Agriculture, Nutrition, and Forestry—U.S. Senate (<http://www.senate.gov/~agriculture/newleg.htm>). Also, <http://www.senate.gov/~agriculture/animalw.htm> for ANIMAL WASTE POLLUTION IN AMERICA: AN EMERGING NATIONAL PROBLEM. Environmental Risks Of Livestock & Poultry Production, December 1997, Report Compiled by the Minority Staff of the United States Senate Committee on Agriculture, Nutrition, & Forestry for Senator Tom Harkin (D-IA) Ranking Member.
15. Farm\*A\*Syst/Home\*A\*Syst (<http://www.wisc.edu/farmasyst/>)
16. Farm Inputs, Resources and Management Related to Water Quality (<http://www.nal.usda.gov/wqic/inputs.html>)
17. USDA, NRCS—Home Page (<http://www.nrcs.usda.gov/>)
18. Farm Service Agency (<http://www.fsa.usda.gov/pas/default.asp>)
19. NRCS Agricultural Waste Management Field Handbook (Contents and how to order) (<http://www.wcc.nrcs.usda.gov/water/quality/common/wastemgmt/wastetable.html>)
20. Animal Waste Management Software (<http://www.ncg.nrcs.usda.gov/tools/awm.html>)
21. Nutrients Available from Livestock Manure Relative to Crop Growth Requirements (USDA-NRCS) (<http://www.nhq.nrcs.usda.gov/land/pubs/nlweb.html>)
22. Manure Master: Decision Support System (<http://db007.ncg.nrcs.usda.gov:6789/ManureMaster/>)

### Universities

23. Pollution Potential of Livestock Manure (Clemson) (<http://gaia.ageng.umn.edu/extens/ennotes/enwin95/manure.html>)
24. Swine Manure as a Fertilizer Source ([http://www.bae.ncsu.edu/bae/programs/extension/publicat/wqwm/ag439\\_4.html](http://www.bae.ncsu.edu/bae/programs/extension/publicat/wqwm/ag439_4.html))
25. Watershed Management: Planning and Managing a Successful Project To Control Nonpoint Source Pollution (NCSU publication) (<http://www2.ncsu.edu/bae/programs/extension/publicat/wqwm/ag522.html>)
26. MARK: Home to NCSU's Extension Swine Husbandry (<http://mark.asci.ncsu.edu/>)
27. Animal Waste and the Environment (GA.) (<http://www.ces.uga.edu/pubcd/c827-w.html>)
28. Florida Agricultural Information Retrieval System. Environmental Structures and Waste Mgmt. Topics: Links to papers out of UFL about animal waste topics. (<http://hammock.ifas.ufl.edu/txt/fairs/19768>) Also Water Quality Topics at <http://hammock.ifas.ufl.edu/txt/fairs/19634>
29. Virginia Cooperative Extension. Poultry Education Resources. Links to information about poultry farming. (<http://www.apsc.vt.edu/Faculty/Clauer/resource/resource.html>)

### Laws

30. Legal Information Institute: Topical Index: State Statutes on the Internet ([http://www.law.cornell.edu:80/topics/state\\_statutes.html#agriculture](http://www.law.cornell.edu:80/topics/state_statutes.html#agriculture))

31. National Center for Agricultural Law (<http://law.uark.edu/arklaw/aglaw/>)
32. Environmental Information, Permits and Law on the WWW. Links to many environmental resources. (<http://ctcnet.net/gdsbm/environm.htm>)
33. Summary of EPA laws that may affect agriculture. (<http://es.epa.gov/oeca/lawsver1.pdf>)

### **Links**

34. Swine Links—IWCC Swine Management Program (<http://www.nishna.net/iwccpig/smplinks.htm>)
35. Page of links—Agricultural/Biological/Environmental—ASAE (<http://asae.org/hotlist/abe/>)
36. Resource Economics and Policy (North Carolina State University) (<http://www.ces.ncsu.edu/PIE/outline.html>). Links to Policy Issues Education Homepage (<http://www.ces.ncsu.edu/PIE/>) and other resources.
37. Progressive Farmer’s list of their favorite internet sites. (<http://progressivefarmer.com/best/index.html>)
38. The Agriculture Webring. This is a circle of connected websites about agriculture. I haven’t really looked at it, but it may be useful. (<http://www.micoks.net/~agring/frames.html>)

### **Statistics**

39. Fact Finders for South Carolina Agriculture (<http://www.nass.usda.gov/sc/>)
40. Statistics: Livestock, Poultry and Dairy—NC (<http://www.agr.state.nc.us/stats/livestoc.htm>)
41. Georgia Agricultural Statistics Service (<http://www.nass.usda.gov/ga/>)

### **Miscellaneous**

42. FAPRI: Food and Agriculture Policy Research Institute (<http://www.fapri.missouri.edu/>)
43. The Ecological Society of America. (<http://esa.sdsc.edu/>) This website includes their latest publication, “Nonpoint Pollution of Surface Waters with Phosphorus and Nitrogen.”
44. Agricultural Conservation Innovation Center (<http://agconserv.com/>)
45. Iowa Hog Confinement (<http://www.salamander.com/~manyhogs/>) Grassroots opposition.
46. Center for Rural Affairs (<http://www.cfra.org/index.html>). Also see Spotlight on Pork III at [http://www.cfra.org/spotlight\\_on\\_pork\\_III.htm](http://www.cfra.org/spotlight_on_pork_III.htm) for a summary of state regulations.
47. National Pork Producers Council (<http://www.nppc.org/>). They also have a chat room at <http://www.nppc.org/wwwboard/wwwboard.html>.
48. National Cattlemen’s Beef Association homepage. <http://www.cowtown.org/>. Also South Carolina Beef Board/South Carolina Cattlemen’s Association. <http://sc.beef.org/>
49. Guide to Environmental Quality in Pork Production (from NPPC) (<http://www.nppc.org/PROD/EnvironmentalSection/environguide.html>)
50. Boss Hog: North Carolina’s Pork Revolution—from the *News and Observer* (<http://www.nando.net/sproject/hogs/hoghome.html>)

51. Animal Waste Management—Idaho (<http://www.oneplan.state.id.us/stock/animal.htm>)
52. “Agriculturally correct” superhero Agman, comic strip designed to appeal to youth. (<http://www.agriculture.com/contents/FFA/agman/>)
53. Council for Agricultural Science and Technology, CAST homepage. (<http://www.cast-science.org/>)
54. Sustainable Farming Connection (<http://sunsite.unc.edu/farming-connection/index.html>) Information for farmers.
55. To see the Power Point slides that were a part of Steve Baker’s talk, “Agriculture is About to Get Very Small,” at Clemson on May 18, 1998, go to <http://hubcap.clemson.edu/scafrrs/seminar.html>. Baker is a division head at AgriBank. He believes that we are on the verge of a new revolution in the structure of agriculture.

## Endnotes

- <sup>1</sup> B. J. Vander Mey, Dept. of Sociology, Box 341513, Bracket 132, Clemson University, Clemson, SC, 29634-1513. Tel: 864.656.3821. Fax: 864.656.1252. E-mail: vanmey@clemson.edu
- <sup>2</sup> Respondents could list up to 4 organizations.
- <sup>3</sup> The most important point here is that there was at least adequate representation of people most likely to be affected by animal agriculture. Problems with how the Census defines “rural” and “urban” and how critiques of surveys envision rural versus urban places are not really addressable in this report. It is recognized that respondents self categorized.
- <sup>4</sup> This pattern is not unusual in survey research. Less educated people tend to be less inclined to participate in surveys while more educated people tend to be more inclined. It should be noted that the bi-modal split between High School Diploma and Some College/Technical Training in this survey (53.5% of the respondents) is similar to the Census figures for adults in South Carolina (48.5%).
- <sup>5</sup> For a discussion see Roe, Terry L. and Munisamy Gopinath. “The ‘Miracle’ of U.S. Agriculture.” *Minnesota Agricultural Economist*, No. 691, Winter 1998.
- <sup>6</sup> Porter, Michael E., and Claas van der Linde. “Toward a New Conception of the Environment-Competitive Relationship.” *Journal of Economic Perspectives*, Vol. 9, No. 4. Fall 1995, pp. 97-118.
- <sup>7</sup> Wohlgenant, Michael K. “Demand for Farm Output in a Complete System of Demand Functions.” *AJAE*, Vol. 71, No. 2, May 1989, pp. 241-252.
- <sup>8</sup> *The Baltimore Sun*. May 26, 1998.
- <sup>9</sup> Sundig, David L. “Measuring the Marginal Cost of Nonuniform Environmental Regulations.” *AJAE*, Vol. 78, No. 4, November, 1996, pp.1098-1107.
- <sup>10</sup> Sharpley, A.N. and J.R. Williams, eds., 1990. EPIC—Erosion/Productivity Impact Calculator: 1. Model Documentation. USDA Technical Bulletin No. 1768.
- <sup>11</sup> Larson,
- <sup>12</sup> Shortle, James S., and James W. Dunn. “The Relative Efficiency of Agricultural Source Water Pollution Control Policies.” *AJAE*, Aug. 1986, pp. 668-677.
- <sup>13</sup> Griffen, Ronald and Daniel Bromley. “Agricultural Run-Off as a Nonpoint Externality.” *AJAE*, Vol. 64 (1982), pp. 547-52.
- <sup>14</sup> Jacobson, Elaine Mullaly, Leon E. Danielson, and Dana L. Hoag. “The Tar-Pamlico River Basin Nutrient Trading Program.” ARE94-1-April 1994, NCSU. <http://www.bae.ncsu.edu/bae/programs/extension/publicat/arep/tarpam.html>.
- <sup>15</sup> *The Augusta Chronicle*. June 22, 1998.
- <sup>16</sup> Palmquist, Raymond B., Fritz M. Roka, and Tomislav Vukina. “Hog Operations, Environmental Effects and Residential Property Values.” *Land Economics*, February 1997, Vol 73 (1) pp114-24.
- <sup>17</sup> *Chicago Tribune news service*. May 6, 1998.

- <sup>18</sup> Thanks to Joy Sherman of DHEC for providing a copy of “Standards for the Permitting of Agricultural Animal Facilities: R.61-43. Bureau of Water, SCDHEC, June 1998 and other fact sheets.
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