

Animal Agriculture in South Carolina

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Animal Agriculture in South Carolina

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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, giving the state one of the most stringent set of conditions for siting and operating confined animal feeding operations in the nation.

DHEC is in the process of revising its regulations. Meanwhile, the controversy over animal agriculture continues. 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 General Assembly Agricultural Productivity and Profitability initiative.

The initial 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.

Animal Agriculture in South Carolina: A Fact Book was released in 1998 and contained many general statistics and the results of a random survey examining South Carolinians’ attitudes about animal agriculture.

Concerns and Tradeoffs

This report marks a continuation of the team’s efforts to provide a sound basis for resolving disputes surrounding animal agriculture. In particular, statistics are updated, and the results of a new survey on the opinions of members of interest groups concerned about animal agriculture are presented.

Formulating public policy involves tradeoffs and compromises among affected citizens. The animal agriculture issue involves a particularly broad array of social, economic, health, environmental and even ethical concerns. Proponents of animal agriculture in South Carolina argue that a viable agricultural sector demands a healthy value-added animal component as an engine of economic growth. Their arguments are bolstered by current low crop prices, and by the search for a replacement for plummeting tobacco income in the state’s highly rural and far less prosperous coastal plain region. They also argue that private property rights give landowners wide leeway to engage in legitimate economic activity, subject only to reasonable restrictions to protect the general public.

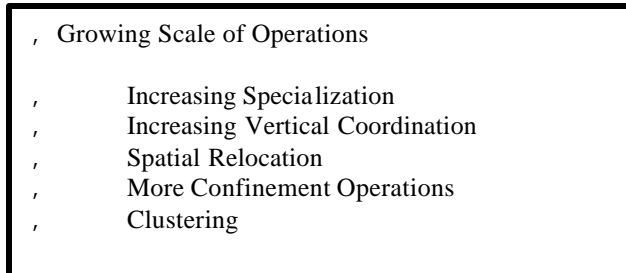
Opponents of an expanded animal industry argue that such operations lead to a decline in water quality, health concerns, and bad smells. They say that even if the production and processing sectors bring more jobs, that they will be of low quality. They tend to believe “big is bad” and talk in terms of corporate agriculture driving out family farms. They believe government should play a very active role in devising rules of conduct for businesses such as animal farms. The evidence used by both sides 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 purposeful 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. The authors have attempted to remain neutral as to the benefits and costs of additional animal farming operations.

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 1). 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 1. Trends in Animal Agriculture



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 of rapidly expanding 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. Processors are becoming fewer and larger as well. As this is being written, the news of Smithfield and Tyson’s rival bids to purchase IBP fills the press.

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 to market weight, 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 Perdue. 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. Today 40 percent of pork volume is accounted for by production contracts, mostly with large producers. Some observers note that this trend is not dissimilar to the movement toward franchising in the fast food and other industries. Like the McDonalds clerk 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 jumped 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 raises 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 earlier 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.

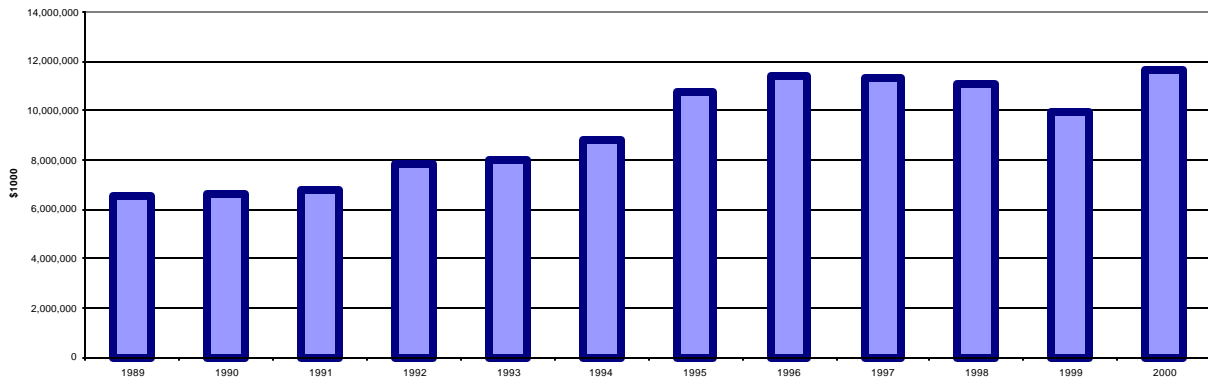
Technology

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 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 one-half 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 1999 (Figure 2).

Figure 2. Value of US Exports of Animals and Animal Products, 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 17 percent of processing while smaller plants processed the other 83 percent. In 1997, 80 percent of plants slaughtering steers and heifers were large plants (over 500,000 animals/year). In 1980, less than one-fourth were large. 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.

Feed Prices

The 1996 Farm Bill freed farmers to produce commodities other than those that previous farm programs locked them in to producing. Animals, as well as alternative crops, could now be produced. Internalizing feed purchase decisions through vertical integration provides a mechanism to cope with price instability, as does the assured regular check provided from a livestock or poultry production contract. In addition, the new law has led to higher corn and soybean acreage, and thus lower feed prices, which encouraged the growth of large, drylot animal feeding operations.

Summary

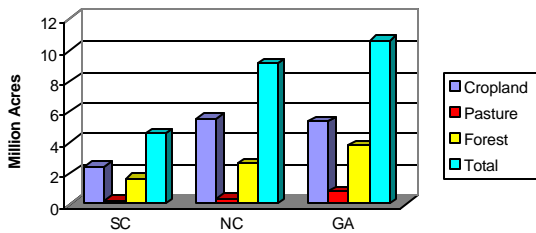
Many citizens have expressed dismay about the changing structure of animal agriculture. Many of their concerns center around the five trends outlined in this section. It is important to note that these forces of change show no signs of abating.

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

Hal Harris

It is hoped that the following 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 3, 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 4). About one-third of the land in each state is in farms, a percentage which has been declining (Figure 5).

**Figure 3. Land Utilization:
SC, NC, GA, 1997**



**Figure 4. Land Utilization:
SC, NC, GA, 1997**

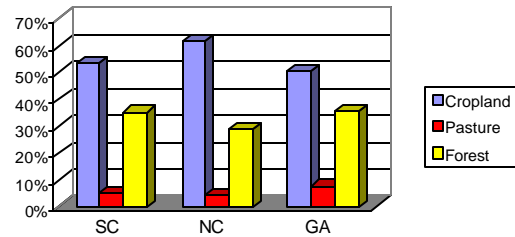


Figure 5. Land in Farms, 1999

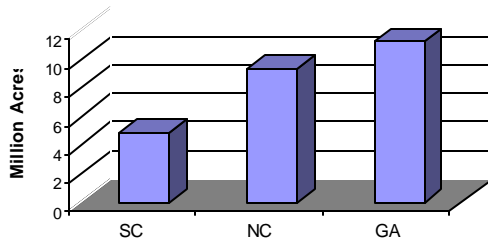
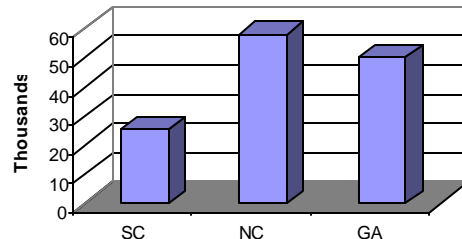


Figure 6. Number of Farms, 1999



North Carolina has many more farms than either South Carolina or Georgia and the average size of farm is quite a bit smaller in terms of acreage (Figures 6 and 7). In terms of dollar sales per farm, South Carolina lags far behind our two neighbors (Figure 8). A major reason is the growth in animal agriculture in North Carolina and Georgia compared to South Carolina.

Figure 7. Average Size of Farm, 1999

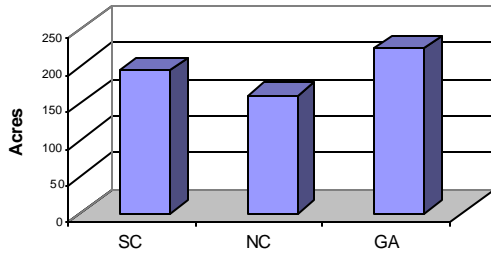
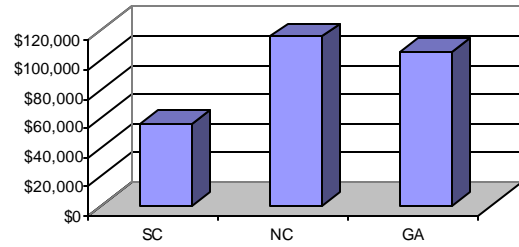


Figure 8. Sales per Farm, 1999



Figures 9 through 13 illustrate trends in animal numbers in the three states during the past 12 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 four years. Declining to steady cattle numbers in South Carolina.
- Dramatic increase in hog production in North Carolina, particularly since 1990. Declining numbers of hogs in the other two states. Note that hog production expanded in North Carolina despite a moratorium on new facilities in 1998. Numbers seem to be leveling out at just under 10 million head.
- 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.
- Declining, but far greater turkey production in North Carolina than the other two states. South Carolina production up.

Figure 9. All Cattle and Calves, Jan. 1: 1988-2000

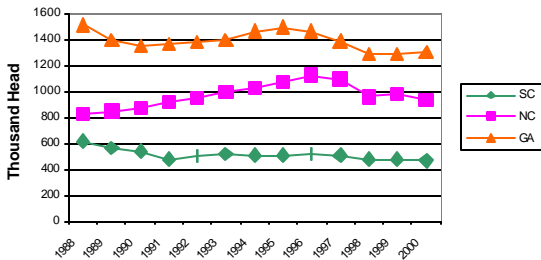


Figure 10. All Hogs and Pigs, Dec. 1: 1986-99

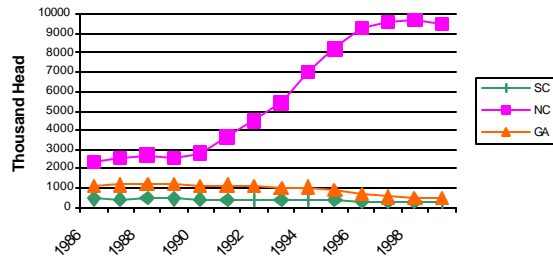


Figure 11. Hens and Pullets of Laying Age, Jan. 1: 1988-1999

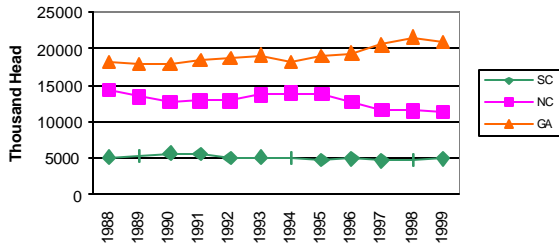


Figure 12. Broilers Produced: 1988-1999

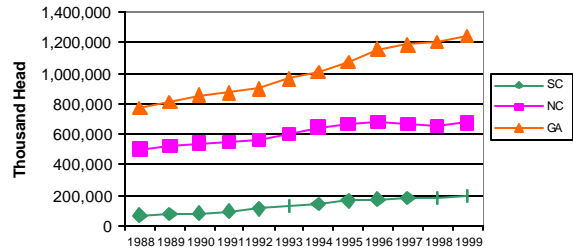
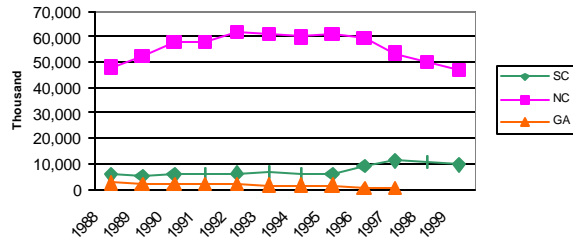


Figure 13. Turkeys Raised: 1988-1999



The next three illustrations (Figures 14, 15, and 16) 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 almost five times as large as South Carolina's; Georgia's is more than three times as large.

Figure 14. Cash Farm Receipts: Crops

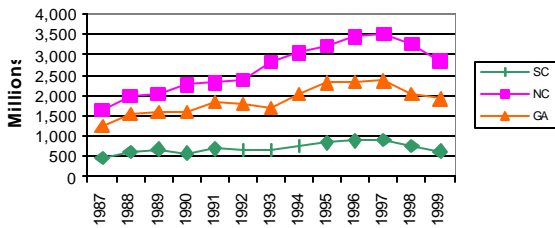


Figure 15. Cash Farm Receipts: Livestock

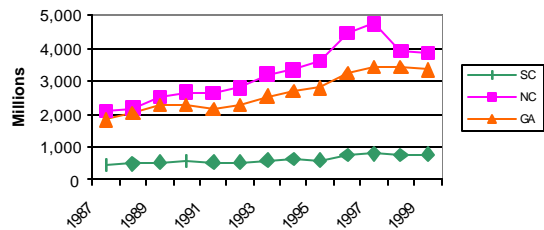


Figure 16. Cash Farm Receipts: Total

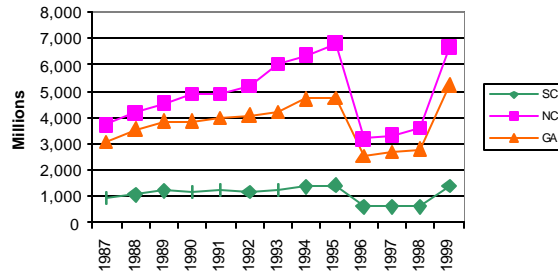
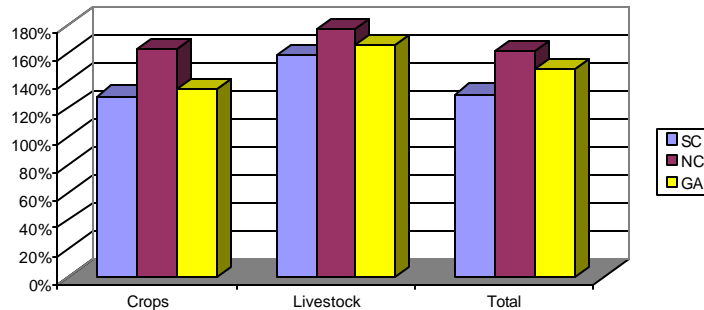


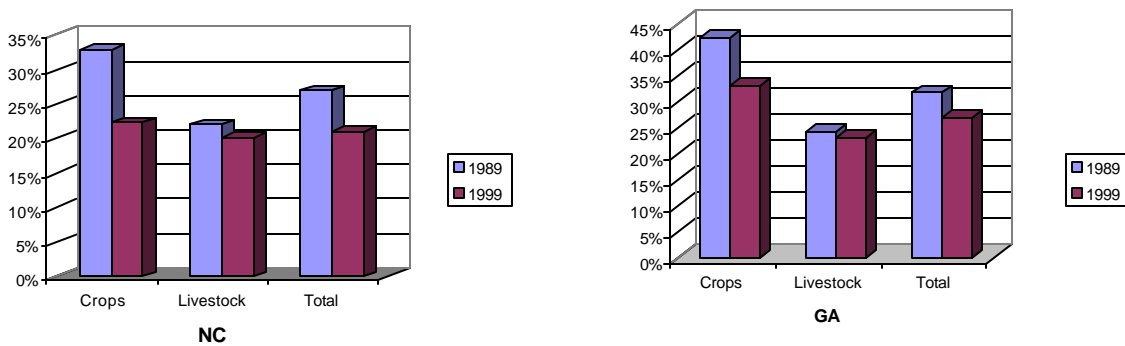
Figure 17 puts these totals in a relative change perspective. Growth in South Carolina’s cash receipts has not kept pace with our neighbors. Income attributable to the poultry and livestock sectors increased 70 percent in North Carolina from 1988 to 1999. In Georgia the increase was 60 percent, and in South Carolina it was 50 percent.

Figure 17. Changes in Cash Receipts, 1988-1999



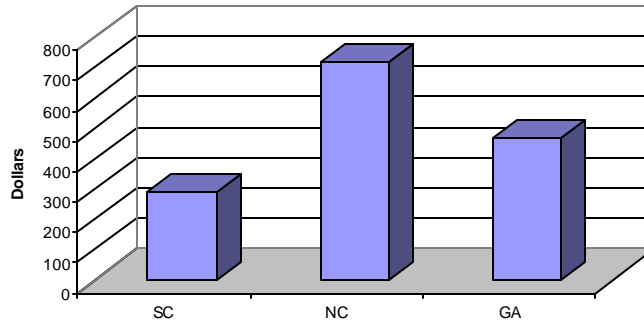
In summary, aggregate farm income in North Carolina and Georgia now dwarfs that in South Carolina, and a major portion of the widening gap has been caused by the growth in animal agriculture (Figure 18).

Figure 18: SC Farm Cash Receipts as a Percentage of NC and GA, Cash Receipts 1989 & 1999



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 1999 were nearly \$700 in North Carolina, around \$400 in Georgia, and only about \$250 in South Carolina (Figure 19).

Figure 19. Sales per Acre of Farmland, 1999



Comparing animal numbers to the total land base provides an 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 20 and 21, the greater is the land base per animal. For example, South Carolina currently has one pig for each 70+ acres; North Carolina has only about 4 acres per hog. Only in turkeys per acre does South Carolina surpass either of the other states - and then only in Georgia.

Figure 20. Acres per Animal, 1999

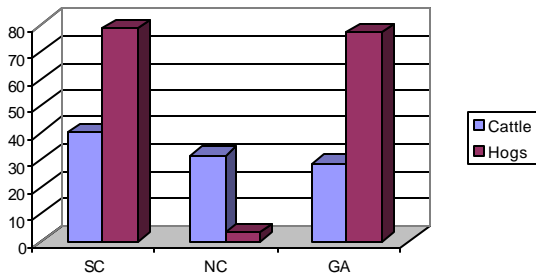
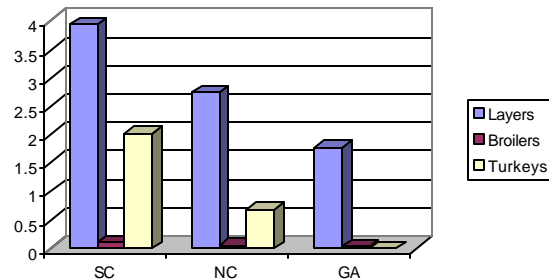
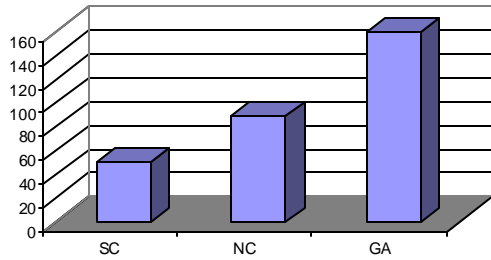


Figure 21. Acres per Animal, 1999

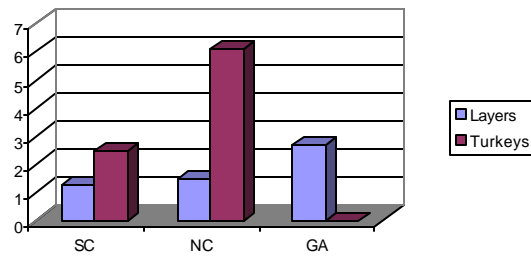


Figures 22, 23, and 24 provide a final basis of comparison among the states. The more animals there are in comparison to people, the greater it would seem the likelihood of incidents of unpleasant interactions in the form of odors, etc. South Carolina annually produces half as many broilers per capita 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.

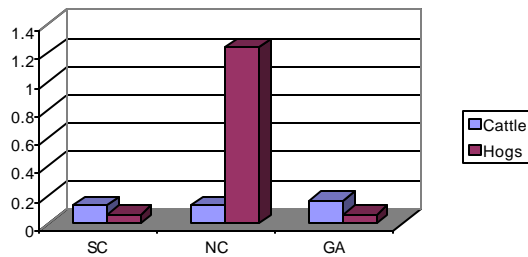
**Figure 22. Animals per Capita, 1999:
Broilers**



**Figure 23. Animals per Capita, 1999:
Layers and Turkeys**



**Figure 24. Animals per Capita, 1999:
Cattle and Hogs**



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 publication will be helpful in achieving more enlightened discussion of the issues involved.

Animal Agriculture in South Carolina: Opinions of Interest Groups and Stakeholders

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Clemson University, Clemson, South Carolina
December 2000**

Executive Summary

The study is a follow-up to an earlier study of South Carolinians' opinions concerning animal agriculture. In 1998, a telephone survey of a random sample of adult South Carolinians (n=700) revealed that 73% would support additional agriculture in their respective counties, even though some also held concerns about ethical issues surrounding animal agriculture, the need for better zoning, the need for tougher regulations, and issues related to property owners' rights.¹

The current study was designed to be more in-depth than the 1998 telephone survey. In addition, there was a stronger focus on ethical and policy issues. This study reveals a fairly consistent pattern of significant differences of opinion among interest groups surveyed. For instance, members of environmental groups showed the strongest support for preserving and providing support for family farms. Members of environmental groups were most likely to say that small farm operations do a better job of protecting the environment, that corporate farms are putting family farms out of business and that corporate farms should not be allowed in South Carolina. Members of agribusiness groups were most likely to agree or strongly agree that animal agriculture is economically important, that additional animal agriculture is worth it economically, and that meats and meat products are safer than ever. The need for tougher environmental regulations received greatest support from environmental groups and members of sports and wildlife organizations. The need for better zoning was perceived as needed more by people involved in planning and development and those in environmental groups than among the other groups. In addition, groups did not hold high opinions of other groups' (especially policy makers and law makers) knowledge of animal agriculture and ability to formulate well-reasoned policies about animal agriculture in the state. In general, those involved in or associated with agribusiness rated policy and lawmakers the highest. Environmentalists did not even hold their own groups in high regard on these two items.

¹Vander Mey, B. J. et al. 1998. "Adult South Carolinians' opinions about animal agriculture." Pp. 10-25 in M. L. Warner, et al., Eds. *Animal Agriculture in South Carolina: A Fact Book*. Report No. EER 172. Clemson, South Carolina: Clemson University, Department of Agricultural and Applied Economics.

With some variation, results of both studies indicate that social problems (crime, drugs, poor education) seem to be weighing more on the minds of South Carolinians than most environmental problems, in general, or problems specifically associated with animal agriculture.

Taken together, these studies indicate that animal agriculture has a great deal of support in the state. However, they indicate that reasoned public discourse is much needed for issues such as zoning, regulation, property rights, ethical treatment of animals, responsibility for the environment, the preservation and support of family farms, and the changing structure of the state's agriculture. The authors theorize that one reason that policy makers are held in low regard in dealing with these issues is the mixed messages they receive from disparate special interest groups. It is recommended that Clemson University take the lead in organizing public dialogue regarding planned land use to help ease current social strain and contribute to outcomes reasonable to all competing interests.

Introduction

Purpose

This current study is a follow-up to a 1998 survey of South Carolinians' opinions concerning animal agriculture. The previous study (a random telephone survey) found that, while most respondents (73%) were supportive of additional animal agriculture in their county, they had concerns about environmental and ethical problems. A majority of respondents (57.7%) agreed that there should be tougher environmental regulations for animal agriculture, and a substantial minority (39.9%) agreed that animal agriculture raises serious ethical concerns about the treatment of animals. This pointed to the need to explore further the nature of the support of and concerns about animal agriculture in South Carolina.

In response to this need, an in-depth, purposive mail-out survey was conducted between April and September of 1999. This survey was designed to determine the knowledge base, opinions, and normative ethical frameworks concerning animal agriculture by groups that were presumed to have strong opinions on the matter. Various groups of industry participants, environmental organizations, regulators, and policy makers were surveyed. This report focuses on general social and policy-related findings. Another report focuses on ethics and ethical issues. The underlying intent was to ascertain where common ground and/or irreconcilable differences of attitudes and opinions existed.

Sampling Strategy

Because this study focused on the opinions of individuals associated with groups that probably have very strong opinions about animal agriculture, purposive sampling was employed. Groups surveyed included members of the South Carolina Farm Bureau Federation, the Cattleman's Association, South Carolina Beef Board, South Carolina Pork Board, the Society of Farm Managers and Rural Appraisers, the South Carolina General Assembly's House and Senate agricultural committees, the South Carolina Chamber of Commerce, South Carolina Association of Counties, Chairpersons of Soil and Water Conservation Districts, various county government and planning boards and associations, Realtor's Association, the Coastal Conservation League, the Sierra Club, South Carolina Sportsman's Coalition, and the South Carolina Wildlife Federation. With exceptions made for very small groups (e.g., Coastal Conservation League and House and Senate agricultural committees), surveys were sent to approximately 10% of the members of each group.

Other groups were asked but declined to participate.

In order to make comparisons between the groups, the surveys were coded by color into seven categories: (1) Agribusiness, (2) Planning and development, (3) Chamber of Commerce, (4) Coastal Conservation/Sierra Club, (5) Realtors, (6) House and Senate agricultural committees, (7) Sportsman's Coalition/Wildlife Federation. For the purpose of analysis, groups with very small numbers (Realtors and House and Senate agricultural committees) were combined with other groups – realtors with the Chamber of Commerce and the agricultural committees with agribusiness. The grouping was based on similarity of responses. Thus, five final group classifications were used for analysis: (1) Agribusiness, (2) Planning/Development, (3) Commerce, (4) Environmental, (5) Sports/Wildlife.

Counties Represented

Forty-five of South Carolina's 46 Counties (all except Allendale) were represented by respondents to this survey. This survey. Nine counties (Aiken, Anderson, Beaufort, Charleston, Greenville, Lexington, Orangeburg, Richland, Spartanburg) had 20 or more respondents. Ten respondents resided outside of South Carolina – most of these in neighboring counties in Georgia or North Carolina. Since these persons belonged to one of the South Carolina-based organizations that were sampled, they were included in the survey, residence status notwithstanding. Two of these individuals called the Principal Investigator, telling her that currently they resided outside the state, but that they owned property in the state, planned to resume residency in the state, and had remained active with these organizations in the state.

Response Rate

One thousand six hundred and twenty-six surveys were mailed. There was an overall response rate of 41.0%. Of the seven original groups surveyed, sports and wildlife had the highest response rate (55.8%), followed by planning and development (40.3%), environmental (37.0%), agribusiness (35.2%), Commerce (24.9%), House/Senate agricultural committees (22.2%), and realtors (13.8%). The response rate for the final five groups (with the agriculture committees combined with agribusiness and realtors combined with the Chamber of Commerce) was 55.8% for Sports/Wildlife, 40.3% for Planning/Development, 37.0% for Environmental, 33.9% for Agribusiness, and 22.5% for Commerce.

The Respondents

Characteristics of the Sample

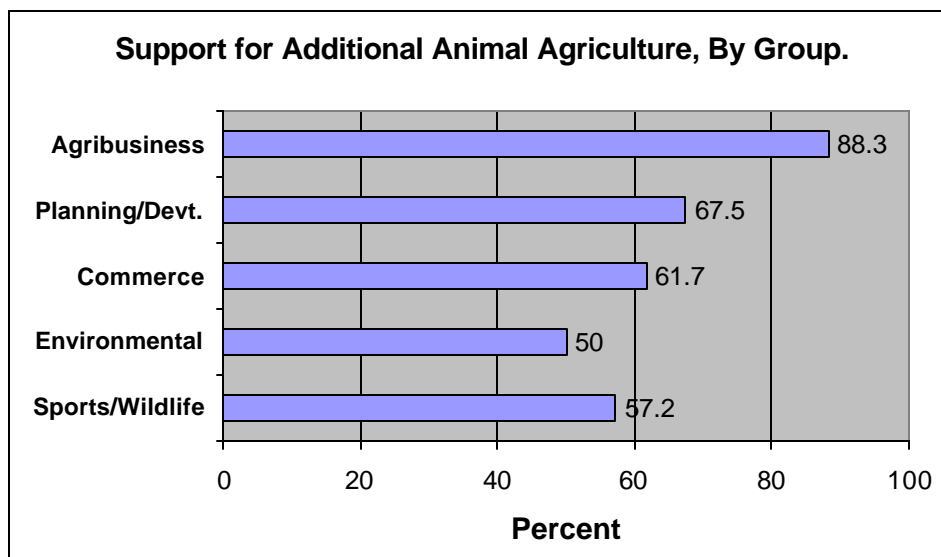
- Slightly over three-fourths of the respondents (76.0%) were male.
- Most respondents (96.6%) were white.
- Most respondents (64.0%) were native South Carolinians.
- Most respondents (84.4%) were married.
- Slightly over one-third of respondents (38.3%) lived on a farm or in a rural non-farm residence.
- Nearly one-third (30.3%) owned or ran a farm or ranch.
- Extremely few respondents (1.7%) said they were vegetarians; only a few more (5.1%) said that there is a vegetarian in the household.
- Age of respondents ranged from 18 to 92, with a mean of 55.5 years.
- Mean estimate of how far respondents live from an animal agriculture operation: 4.7 miles.
- Mean estimate of percent of respondents' income derived from farming: 10.4%.
- Most (80.8%) said that animal agriculture was important to the economy of their county.
- Group category: 49.5% Sports/Wildlife; 18.7% Planning/Development; 18.1% Agribusiness; 10.6% Commerce; and, 3.0% Environmental.

Findings

Support for Additional Animal Agriculture

Although 65.2% of respondents said they were willing to support additional animal agriculture in their county, responses varied significantly according to group (see Figure 1). Agribusiness indicated the greatest proportion of support (88.3%), and the environmental groups indicated the lowest (50.0%). Planning and development (67.5%), commerce (61.7%), and sports and wildlife groups (57.2%) also were willing to support additional animal agriculture.

Figure 1. Support for Additional Animal Agriculture, by Group.



Analysis by residence type revealed, not surprisingly, that respondents residing on farms and in non-farm rural residences were most likely to say that they agree or strongly agree that they would support additional animal agriculture in their respective counties. However, in no residence type did support dip below 50% of the respondents in that category.

In addition, with several of the residence categories, nearly one-third of the respondents indicated that they just didn't know or were unsure about additional support, rather than simply disagreeing or strongly disagreeing. Thus, the fact that animal agriculture is supported is fairly clear. Also, it is reasonable to expect that some uncertainty exists among respondents.

Percent agreeing or strongly agreeing, unsure or don't know, and disagreeing or strongly disagreeing that they would support additional animal agriculture in their respective counties, broken down by residence type, are as follows:

Chart 1. Willingness to Support Additional Animal Agriculture in the County, by Residence Type.

	Agree/Strongly Agree	Don't Know/Not Sure	Disagree/Strongly Disagree
Farm	89.1%	7.6%	3.4%
Rural, non-farm	70.5%	17.6%	13.0%
Small Town (<4000)	53.7%	35.8%	10.5%
Medium Town 4001-10k)	69.0%	16.2%	14.9%
Large Town (10,00-25 K)	54.5%	34.1%	11.3%
Medium City (25K-50K)	57.3%	28.0%	14.7%
Large City (50K+)	51.1%	32.8%	16.0%

Respondents were asked to list reasons for their willingness or unwillingness to support additional animal agriculture. Of those who supported animal agriculture, 33.9% said this was because animal agriculture would help the economy or provide jobs; 18.1% said that animal agriculture was a necessary industry; 10.7% said that they wanted to protect the family farm or the rural way of life; 6.9% said to allow for free enterprise; and 6.1% said that the land was available or that it was suitable to their county. Other responses were that they were willing to support family farms but not corporate farms (5.9%), that they were willing to support additional animal agriculture only if the operations met environmental or odor concerns (5.9%), or that they support additional operations because they believed this would restrict urbanization or curtail growth (5.6%).

Of those who were unwilling to support additional animal agriculture, 29.9% said that this was because it was not appropriate for their county; 24.3% mentioned environmental concerns; 15.0% said they were opposed to corporate or mass farming; 13.1% mentioned odor concerns; and 7.5% cited economic reasons. Other respondents said that they needed more information before they would be willing to support animal agriculture (6.5%), that they had ethical concerns (3.7%), or that they thought public opinion was not favorable toward additional animal agriculture (1.9%).

Enterprises That Respondents Would Support

Respondents were asked to list the top three enterprises or activities they would be willing to support if their county had to vote to bring in the next job creating enterprise. Of those who responded (n=453), half (50.8%) said they would be willing to support manufacturing or industrial enterprises. Many of these respondents stipulated that they would only support clean

(i.e., environmentally safe) industries or light manufacturing. Nearly one-third (30.7%) of the respondents said they would support high tech industries, such as computers or electronics. About one quarter (25.6%) of the respondents said they would support agriculture (generic term) and related industries, and 20.5% listed animal agriculture as one of their top three preferred enterprises. Other enterprises listed included service industries (8.8%), automotive industries (8.8%), building and construction industries (8.8%), distribution/warehousing systems (7.3%), recreation/theme parks (6.6%), forestry/timber industries (6.2%), medical industries (5.5%), textiles (5.5%), and “anything that provides clean, well-paying jobs” (5.1%).

Figure 2 depicts willingness to support the five most frequently mentioned enterprises by group. The number of respondents per group who gave an answer is identified in the parenthesis in the legend for the table. On the chart, the percent of the entire group (not just those responding) is graphed. In this way, we can see what percent of each group was willing to support which enterprises.

As can be seen, manufacturing/industry was most strongly supported by planning and development (48.8%) and commerce (43.7%). About one-third (32.4%) of those in the sports/wildlife groups would support manufacturing, while under one-fourth (23.1%) of those in agribusiness and almost none (1.5%) in environmental groups would.

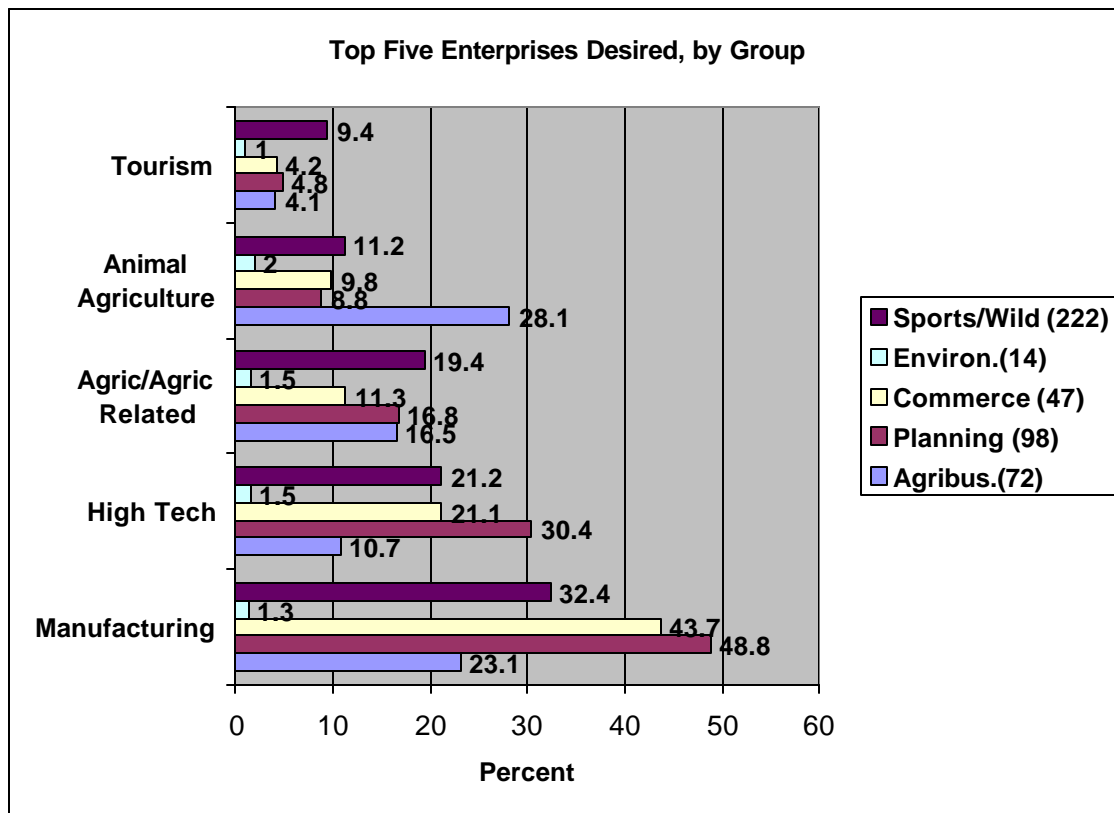
High tech industries had greatest support among planning and development groups (30.4%), followed by sports/wildlife (21.2%) and commerce groups (21.1%), with little support from agribusiness groups (10.7%) and nearly none (1.5%) from environmentalists.

Agriculture and related industries (e.g., processing plants) was most often mentioned by those in the sports/wildlife groups (19.4%). Surprisingly, slightly more, proportionately, of those in the planning and development groups (16.8%) than those in the agribusiness groups (16.5%) listed agriculture (just as a generic term) or agriculture-related industries. Again, very few (1.5%) of the environmentalists mentioned this category of industry.

Animal agriculture, not surprisingly, was listed as a category by itself. And, also not surprisingly, proportionately more individuals in the agribusiness group (28.1%) specifically mentioned animal agriculture as one the top three enterprises they would support. Animal agriculture was mentioned by 11.2% of those in sports/wildlife groups, 9.8% of those in the commerce groups, 8.8% of those in the planning/development groups, and by only 2. % of those in the environmental groups.

Tourism was most frequently (9.4%) mentioned by members of sports/wildlife groups. As Figure 2 depicts, tourism was not a high priority enterprise among the other groups.

Figure 2. Enterprises that Respondents are Willing to Support, by Group



When asked why animal agriculture was or was not on their list of the top three job creating enterprises they would be willing to support, responses were somewhat similar to the reasons for overall willingness to support additional animal agriculture. Of those who listed animal agriculture, 21.1% (n=114) said they did so because animal agriculture is a necessary industry; 19.3% said the area was suitable; 17.5% said that they thought it would create jobs or boost the economy; 17.5% said to maintain a rural way of life; and 10.5% said to create economic balance/diversity. Other reasons included were “to help farmers” (13.2%), to keep food in local economy (7.0%) and because animal agriculture can be a clean and safe enterprise (4.4%).

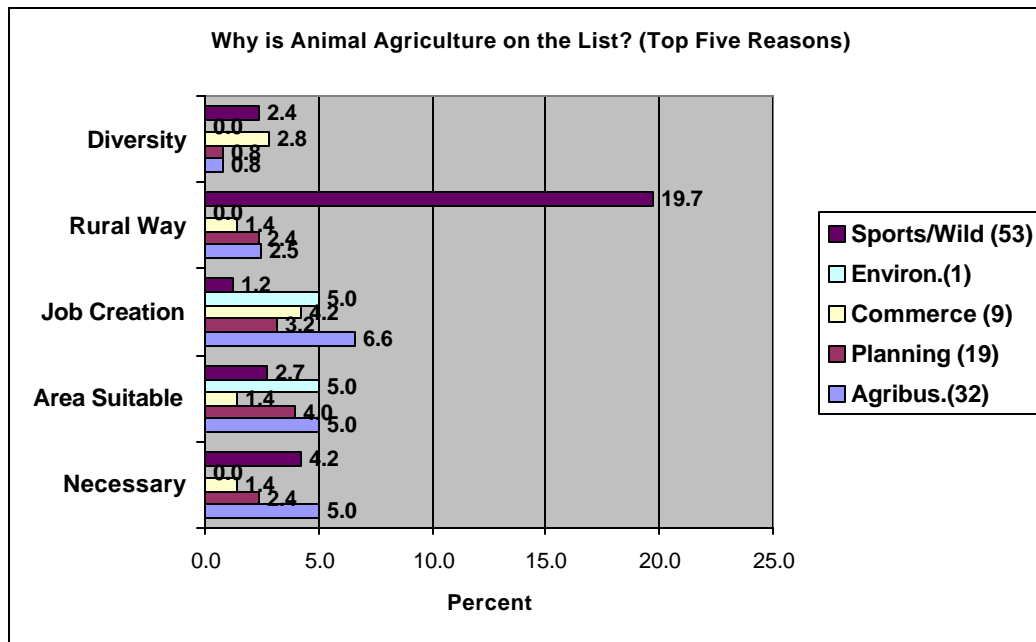
A breakdown, by group, of the most frequently given reasons for listing animal agriculture appears in Figure 3. The number of respondents per group who gave an answer is identified in the parenthesis in the legend for the table. On the chart, the percent of the entire group (not just those responding) is graphed. Thus, the relative proportion of people in each group giving an answer is depicted.

As can be seen, when shown in this comparative, proportionate fashion, the reason that shows glaring differences among the groups is “to maintain a rural lifestyle.” On this score, the sports/wildlife respondents (19.7%) were overwhelmingly most likely to give this response. More respondents from agribusiness (5.%) , the environmental groups (5.%) and

planning and development groups (4.%) had put animal agriculture on the list because the area was suitable than did the sports/wildlife groups (2.7%) and the commerce groups (1.4%).

While no group gave overwhelming endorsement to including animal agriculture as an acceptable new enterprise, proportionately more respondents from agribusiness (6.6%) and the environmental groups (5.5) did so in comparison to the commerce groups (4.2%), the planning/development groups (3.2%), or the sports/wildlife groups (1.2%). Interestingly, while no respondents from the environmental groups thought animal agriculture is a necessary additional enterprise, it got few responses from agribusiness (6.6%) along these lines as well.

Figure 3. Reasons Animal Agriculture is on the List

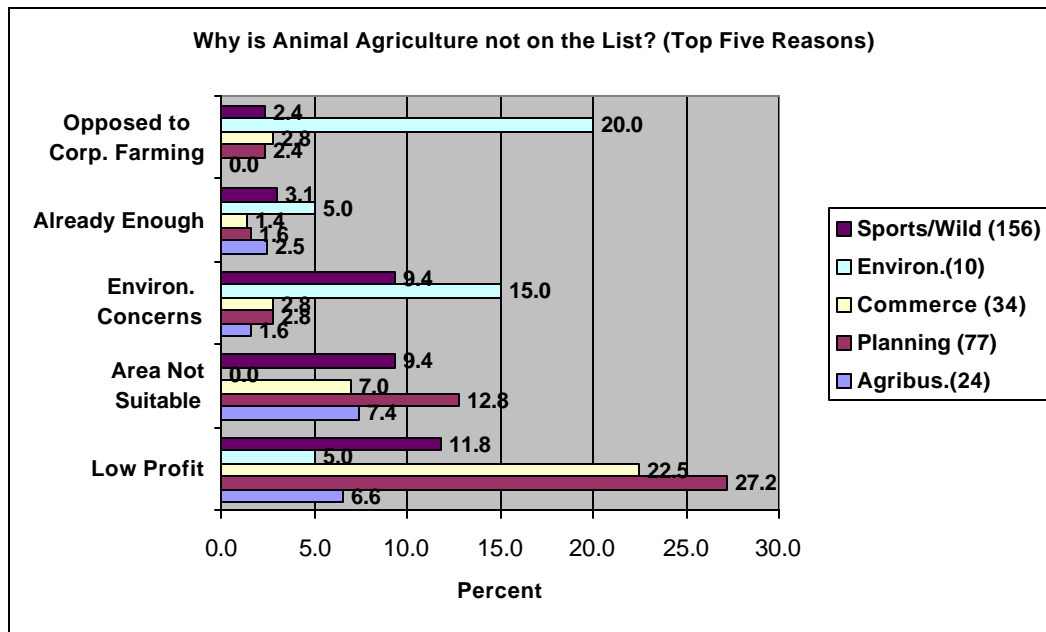


Of those who did not list animal agriculture as one of their top three preferred industries, 37.7% (n=260) said this was because it creates too few jobs or has low profits; 23.5 % said that the area was not suitable for it; 18.8% said that they had environmental concerns; 6.5% said there was already enough animal agriculture; and another 6.5% said it was opposed to corporate farming. Other responses included statements to the effect that animal agriculture causes odor problems (6.2%), that more information about animal agriculture would be needed in order to list it (5.0%), that it just isn't a top priority (5.0%), and it just isn't needed (3.5%).

Figure 4 provides a breakdown, by group, of the most frequently given reasons for not listing animal agriculture as one of the top three new enterprises that respondents would support. The number of respondents per group who gave an answer is identified in the parenthesis in the legend for the table. On the chart, the percent of the entire group (not just those responding) is graphed. As with Figure 3, then, the relative proportion of people in each group giving an answer is depicted.

Proportionately more respondents from planning/development groups (12.8%) and sports/wildlife groups (9.4%) said that the area is not suited for additional animal agriculture, compared to 7.4% of those in agribusiness, 7.0% of those in commerce, and none of the environmentalists. Planning/development groups (27.2%) and commerce groups (22.5%) were proportionately far more likely to say that animal agriculture was not included as a priority because it brings low profits and creates few jobs. Respondents from environmental groups (15%) were most likely to say that animal agriculture was not a top three choice for new enterprises because of environmental concerns, followed by sports/wildlife groups (9.4%) planning/development groups (8.8%), commerce groups (2.8%) and respondents from agribusiness groups (1.6%). Across the board, proportionately few respondents offered either the idea that there already was enough animal agriculture or that they were opposed to corporate farming. While a few in each group did this (except for agribusiness and the corporate farm statement), it is safe to say that these reasons are not pressing in the minds of the respondents in this study.

Figure 4. Reasons Why Animal Agriculture is Not on the List



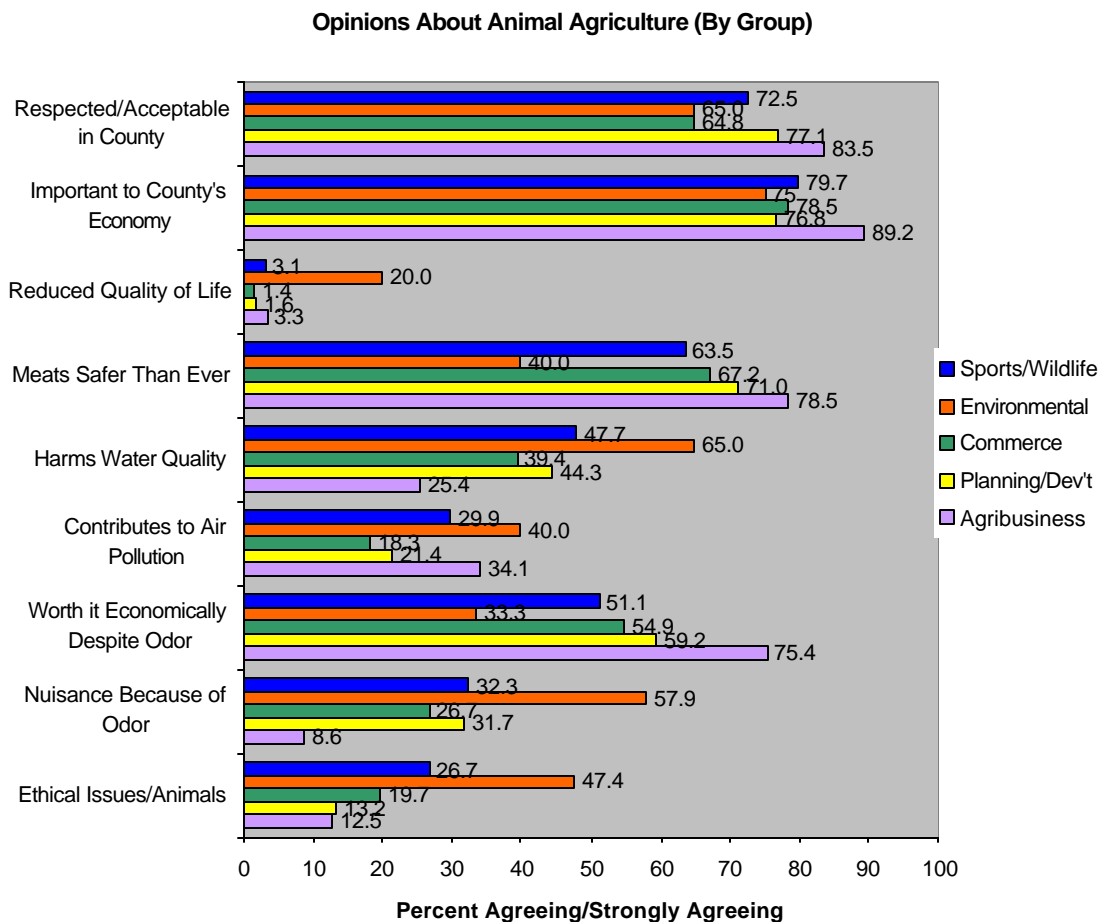
General Opinions on Animal Agriculture

Respondents were asked several questions regarding their general opinions and concerns about animal agriculture (see list below). They were asked whether they strongly disagree, disagree, don't know or are not sure, agree, or strongly agree with each statement. For most statements, responses varied significantly according to group classification. Figure 5 depicts the percentage of each group that said they agree or strongly agree.

Statements given to respondents:

- “In my county, animal agriculture is a respected and acceptable business and way of life.”
- “Animal agriculture is important to the economy in this county.”
- “Animal agriculture has reduced the quality of life for me.”
- “Today’s meats and meat products are safer than they have ever been.”
- “Farm animal wastes significantly harm water quality.”
- “Animal agriculture contributes to air pollution.”
- “Given the potential for animal operations to cause odors, do you think having these operations in your county is worth it economically?”
- “Animal agriculture is a nuisance because of the odor.”
- “Animal agriculture raises serious ethical questions about the treatment of animals.”
- “Animal agriculture has negative effects on property values.”

Figure 5. General Opinions on Animal Agriculture.



Only statements showing significant differences are graphed. p#.05.

Summary of Concerns About Animal Agriculture

- Overall, respondents were supportive of additional animal agriculture, though some groups were more supportive than others. Those connected to agribusiness were most supportive, while those involved in environmental organizations were least supportive. Nevertheless, respondents had several concerns. Opinions about these concerns varied by group, and in some areas there was more agreement than in others.

Areas of General Agreement

- A large majority of each group agreed that animal agriculture was respected and acceptable in their county and that it is important to the county's economy.
- Very few respondents of any group agreed that animal agriculture had reduced their quality of life, though a larger percent of the environmental group (20%) agreed than the others.
- A substantial minority (40%) of the environmental group agreed that animal agriculture contributes to air pollution, but other groups were less inclined to agree. In contrast to the respondents from the environmental groups, those from commerce groups (18.3%) were less likely to rank this item as something to which they would agree or strongly agree, followed by planning/development groups (21.4%), sports/wildlife respondents (29.9%) and then those in agribusiness (34.1%).

Areas of Disagreement

- Large majorities of the other groups agreed with the statement that "Today's meats and meat products are safer than they ever have been," while only 40% of the environmental group agreed. Agribusiness respondents (78.5%) were most likely to agree or strongly agree that today's meats are safer than ever, followed by respondents from planning/development (71.%), and then by respondents from commerce groups (67.2%) and those in the sports/wildlife groups (63.5%). Thus, on this item, there is a divide between the environmentalists and the other respondents, and especially between the environmentalists and respondents from agribusiness groups.
- 65% of the environmental group agreed that animal waste significantly harms water quality, compared with only 25.4% of agribusiness. Other groups fell somewhere in between. Nearly half of the sports/wildlife respondents (47.7%) agreed or strongly agreed with this statement, followed by planning/development respondents (44.3%) and then by commerce respondents (39.4%)
- Very few (8.6%) of the respondents in the agribusiness group agreed that animal agriculture was a nuisance because of the odor, compared with a majority (57.9%) of

the environmental group. About one-third of the sports/wildlife respondents (32.3%) and planning/development (31.7%) strongly agreed or agreed that animal agriculture causes problems with odor. Only slightly over one-fourth of the respondents from commerce (26.7%) ranked the statement in this way.

- A large majority of agribusiness (75.4%) agreed that animal agriculture is worth it economically in spite of the odor, while only a third of the environmental group agreed. A slight majority of each of the other groups agreed to this.
 - Proportionately fewer environmental groups strongly agreed or agreed that animal agriculture was worth it despite the odor (33.3%) than agreed or strongly agreed that animal agriculture is a nuisance because of odor (57.9%). While the differential in the scoring of these two items is greatest among the agribusiness group (8.6% saying animal agriculture is a nuisance because of odor, yet 75.4% agreeing or strongly agreeing that it is worth it despite the odor), the chart below shows that there is room to be skeptical that just because odor is associated with animal agriculture, odor alone would dissuade people from respecting it for its economic value.
 - Chart 2. Groups' Opinions About Odor and The Relative Value of Animal Agriculture.

	Odor Nuisance	Worth it \$\$ Anyway	Differential
Agribusiness	8.6%	75.4%	+66.8
Planning/Development	31.7%	59.2%	+27.5
Commerce	26.7%	54.9%	+28.2
Environmental	57.9%	33.3%	-24.6
Sports/Wildlife	32.3%	51.1%	+18.8

- Almost half (47.4%) of the environmentalists agreed that animal agriculture raises serious ethical questions about the treatment of animals, compared to only about a fourth (26.7%) of the sports and wildlife group and even lesser percentages of the others.

Ethical and Safety Concerns

Though a minority, some respondents had concerns about the safety of meats and the ethical treatment of animals. Overall, 21.7% (n=188) of respondents said they avoided some meats for safety reasons, while 18.2% (n=107) said they avoided some meats for ethical reasons. Agribusiness had the smallest percentage of meat avoidance, and the environmental group had the largest. Specifically, almost two-thirds (64.7%) of the environmental group said they avoided some meats for safety reasons.

Chart 3 depicts the proportions of respondents from each group who said that they avoided some meats for ethical reasons and the proportion from each group who avoid meats

for safety reasons. As can be seen, with only one exception (Sports/Wildlife) respondents tended to be more inclined to avoid meats for safety reasons rather than for ethical reasons.

- Chart 3. Proportions of Each Group Who Avoid Meats for Safety or Ethical Reasons.

	Avoid Meats for Ethical Reasons	Avoid Meats for Safety Reasons
Agribusiness	1.6%	5.5%
Planning/Development	9.6%	15.2%
Commerce	16.9%	22.5%
Environmental	30%	55%
Sports/Wildlife	22.7%	18.8%

Respondents who avoided meats for ethical or safety reasons were asked to list which meats or meat products they avoid. Respondents who said they avoid meats for safety reasons reported a wide variety of meats that they avoid. Foremost were chicken and poultry (15.3%), followed by packaged or processed meats (12.7%). Other responses were ground beef (11.9%), hot dogs (10.2%), beef (10.2%), and hormone/chemical injected meats (7.6%).

Veal was the meat most widely avoided for ethical reasons. Of the respondents who reported avoiding some meats for ethical reasons, 60.7% said they avoided veal. No other meat was so widely avoided, but respondents reported avoiding a wide variety of other meats, such as lamb (13.1%), pork (13.1%), tuna (9.3%), chicken and poultry (8.4%), swordfish (7.5%), and beef (6.5%).

Responsibility for Ethical Issues Related to Animals

When asked to write in who, if anyone, should be held responsible for ethical issues surrounding the treatment of animals, 393 respondents offered at least one suggestion. Slightly over one-third (36.1%) said the government should take responsibility, while about one-fourth (26.0%) said that farmers and/or farmers' organizations should take responsibility. Roughly one-fifth (20.4%) said that everyone or citizens should take responsibility for these concerns. Other responses included "no one" (8.7%), the operator/owner (7.1%), consumers (5.6%), and the Department of Agriculture (3.6%). A few others indicated that schools (1.8%) should be responsible for these issues, and a very small minority (0.3%) said that the market should handle this. Interestingly, no one indicated that animal rights groups should take on this responsibility.

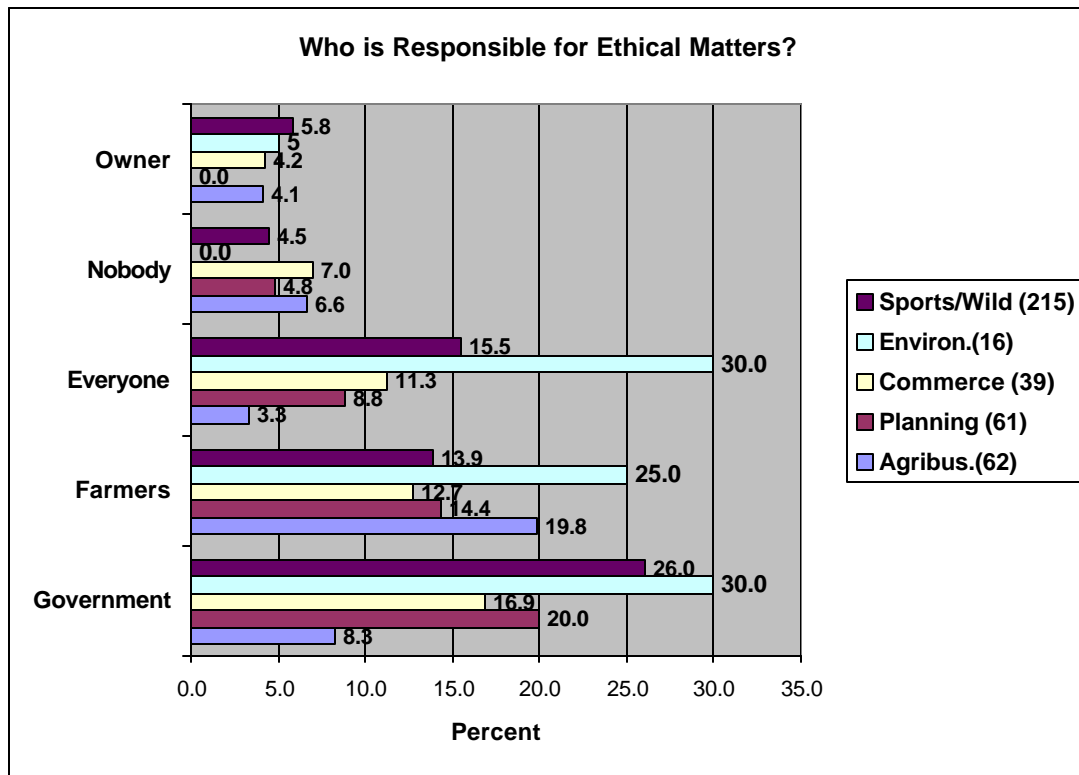
Figure 6 displays the top five responses, by group, that respondents gave to the question of who if anyone should be responsible for ethical issues associated with animal agriculture. As can be seen, agribusiness (8.3%) was proportionately least likely to say that the government should be responsible, followed by commerce groups (16.9%), planning/development (20%), sports/wildlife respondents (26.%) and then by environmental group members (30%). One-fourth (25%) of the respondents from environmental groups said that farmers should be held responsible for ethical issues, followed closely by respondents from agribusiness (19.8%), and then by planning/development groups (14.4%), sports/wildlife

respondents (13.9%), and last by respondents from commerce (12.7%). Right at one-third (30%) of the respondents from environmental groups thought that everyone should be held responsible for ethical issues associated with animal agriculture. About half that proportion of respondents from sports/wildlife groups (15.5%) gave this response. Slightly over one-tenth (11.3%) of respondents from commerce said that everyone is responsible, and slight under one-tenth (8.8%) of respondents from planning/development gave this response. Respondents from agribusiness (3.3%) were least likely to list this answer.

As previously indicated, less than ten percent (8.7%) of the respondents indicated that no one should be held responsible for the ethical issues associated with animal agriculture. No respondents from environmental groups wrote this in as an answer. Only 4.5% of the respondents from sports/wildlife groups gave this response. The response was only nominally present among respondents from planning and development (4.8%), agribusiness (6.6%), and commerce (7%) respondents.

Even fewer (7.1%) of the respondents indicated that owners should be held responsible for ethical issues associated with animal agriculture. While planning/development respondents did not list the owner as responsible, at the same time the other groups show extremely infrequent listing of this as well.

Figure 6. Who is Responsible for Ethical Concerns Related to the Treatment of Animals?



The Large, Small, and Family of It

Respondents were asked a variety of questions about their opinions toward family (or small) farms versus corporate (or large) farms (see list below).

Statements given to respondents were:

- “Government policies should focus on making small animal operations more efficient.”
- “Corporate farms are driving family farms out of business.”
- “Corporate animal operations should not be permitted to operate in South Carolina.”
- “It is important that family farms be preserved.”
- “Large animal operations get too much assistance from government programs.”
- “Family-run operations should be supported even if it means higher food prices.”
- “Farmers with small livestock operations do a much better job of protecting the environment than do farmers with large livestock operations or corporate farms.”

Summary of Opinions on Corporate and Family Farms

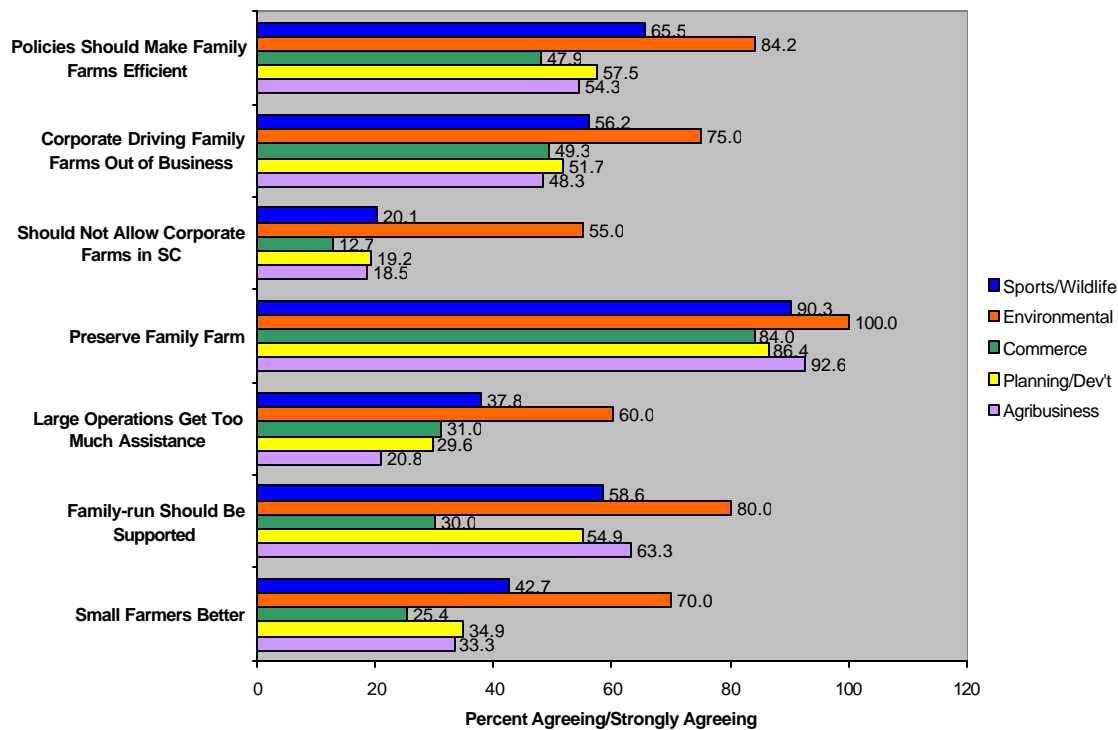
- Though there were some big differences concerning related issues, respondents of each group expressed support for the family farm. Well over two-thirds of respondents agreed that it is important that the family farm be preserved. There seemed to be more disagreement, however, on how (and even why) this was to be done.
- Few respondents (19.9%) thought corporate farms should be banned from South Carolina, although 55% of the environmental group agreed.
- Few respondents (33.1%) thought large operations get too much assistance from the government, though 60% of the environmental group agreed.
- A majority or near majority of each group agreed that corporate farms are driving family farms out of business.
- A majority of each group except commerce (30%) agreed that family-run operations should be supported even if it means higher food prices.
- The environmental group was most supportive of small or family farms and least positive about large or corporate farms. Over two-thirds (70%) of this group (compared with minorities within the other groups) agreed that small farms do a better job of protecting the environment. This belief likely accounts for their general support for family farming.

Slightly over half (56.3%) of the respondents indicated that family farming should be supported even if it meant higher food prices. When asked how much more they were willing to pay for food in an effort to preserve family farms, one-fourth (24.4%) of those responding (n=636) said that they weren't willing to pay more than they already are, while another fourth (25.6%) said they would pay an additional one to nine percent and one-third (30.7%) responding said that they would pay between 10 and 15 percent more. About one-tenth of those responding to this item said that they would pay up to 25% more, and the remainder indicated that they would pay 25-40% more (3.5%), 41-50% more (2.0%), 51-75% more (.5%), 76-100% more (1.1%), or more than twice as much (1.3%).

Figure 7 provides a breakdown of response patterns by group for all items on which there were significant differences between groups. Based on these data, the environmental groups can be described as either biased toward family farms or biased against corporate farms, or both. Proportionately more respondents from environmental groups agreed or strongly agreed that the family farm should be preserved (100%), that the family farm should be preserved even if it means higher food prices (80%), that large operations get too much government assistance (60%), that corporate farms are running family farms out of business, that small farm operators do a better job of protecting the environment than do larger or corporate farms (70%), and that corporate farms should not be allowed in South Carolina (55%).

Figure 7. Opinions on Family and Corporate Farming.

Opinions on Corporate vs. Family Farming (By Group)



Only statements showing significant differences are graphed. p# .05.

Respondents were asked to write down what comes to mind when they hear the term “family farm.” Most (572) respondents wrote down at least one word or phrase. Just under one-third used the term “family owned” or “family operated” (31.8%) and described a family farm as either small or medium sized (30.1%). Other descriptions of family farms included “strong moral character” (15.0%), “passed generation to generation” (12.4%), a “tradition/way of life” (8.9%), and/or “environmentally friendly” (6.3%). A few respondents (5.8%) wrote that the term evokes bucolic images. Other descriptions included “individually owned/operated” (5.1%), “unprofitable” (4.2%), and “well-run/efficient” (1.9%).

Of the 601 respondents describing what comes to mind when they hear the term “corporate farm,” most said “big/mass production” (62.9%). Some described corporate farms as “profit-driven” (14.8%), while others used terms such as “hog farm” (8.5%), “absentee ownership” (6.8%), “environmentally hazardous” (6.3%), “confined/mistreated animals” (5.2%), “efficient or well-managed” (4.3%), and/or operations that “put small farms out of business” (4.2%). A few said that the term made them think of something that was government subsidized (3.2%), and a few said that the term made them think of poultry (4.2%). Other images included “technology/equipment” (3.2%) and “North Carolina” (2.0%).

Does Anyone Know Anything?

Respondents were asked about their perceptions of various groups' knowledge or competency concerning animal agriculture (see list below.) Figure 8 shows the responses of each group of respondents.

Statements given to respondents:

- “Generally speaking, environmental groups know enough about animal agriculture that they can effectively propose well-reasoned policies regarding the regulation of animal operations.”
- “Environmentalists exaggerate problems associated with animal agriculture.”
- “When it comes to regulating animal operations, most lawmakers know enough about animal agriculture to formulate well-reasoned policy about it.”
- “Policy makers in this state have formulated laws that reasonably regulate animal agriculture.”
- “Policy makers in this state are knowledgeable about animal agriculture.”
- “The United States EPA is doing a good job of regulating animal agriculture operations in this state.”
- “The South Carolina Department of Agriculture is doing a good job of regulating animal operations.”
- “South Carolina’s DHEC (Department of Health and Environmental Control) is doing a good job of regulating animal agricultural operations.”

Summary Opinions on Knowledge of Animal Agriculture, Policy-Making Ability

- Overall, respondents seemed to have very little confidence in the ability of anyone – lawmakers, environmentalists, or government agencies – to make well-informed policies concerning animal agriculture.
- Few respondents of any group agreed that environmentalists are knowledgeable enough to propose well-reasoned policies concerning animal agriculture. Only 45% of the environmental group agreed that environmentalists were knowledgeable enough to do this. Moreover, a large majority of most groups agreed that environmentalists exaggerate the problems associated with animal agriculture. (However, only 50% of the Sports and Wildlife group agreed, and only 20% of the environmental group agreed with this statement.)
- Very few respondents of any group agreed that lawmakers or policy makers are knowledgeable enough about animal agriculture to form well-reasoned policy about it.
- There was little confidence in the current regulation by the EPA, the South Carolina Department of Agriculture, or DHEC. On these matters, however, agribusiness was more supportive of the current government regulation than other groups were.

Opinions on Knowledge of Animal Agriculture (By Group)

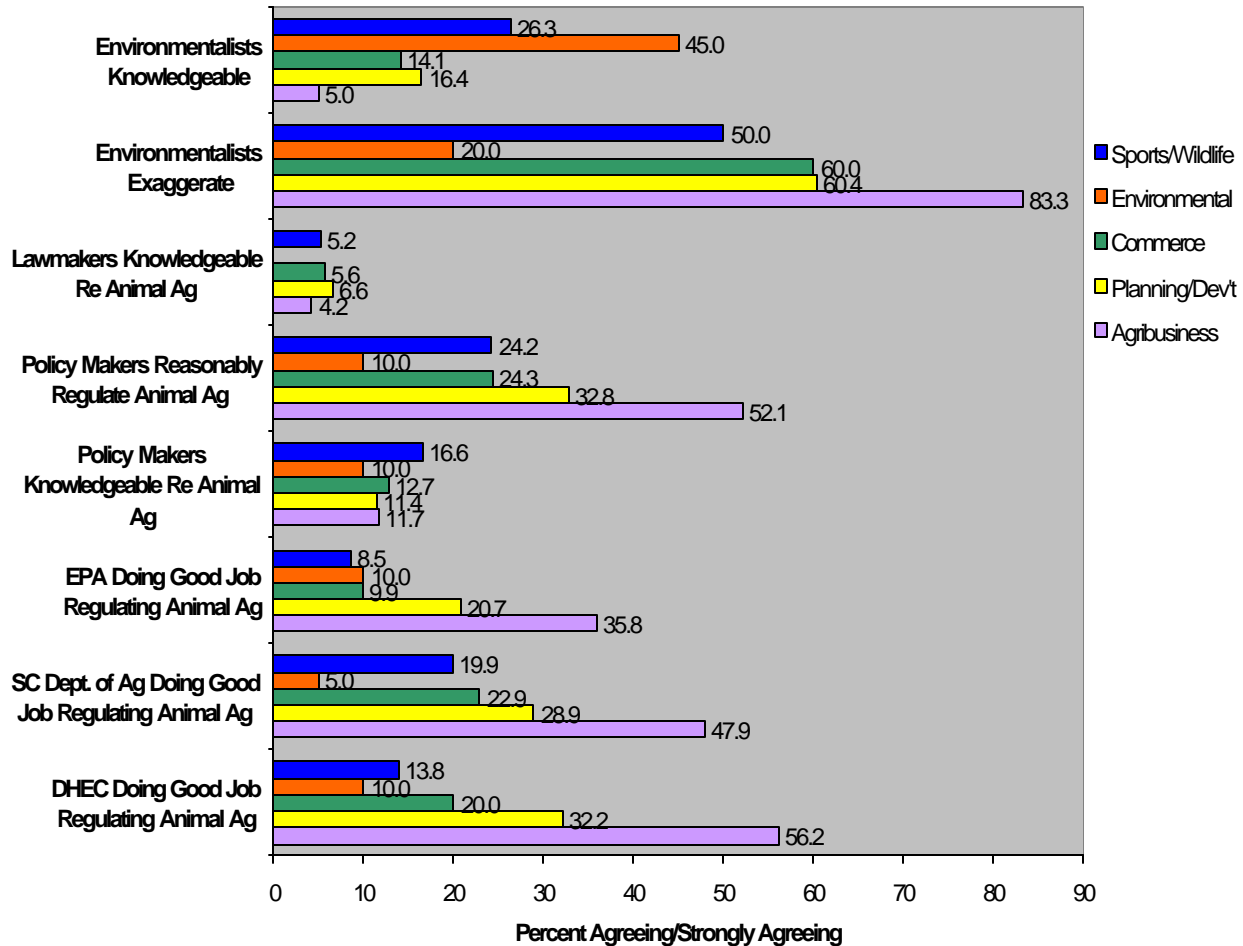


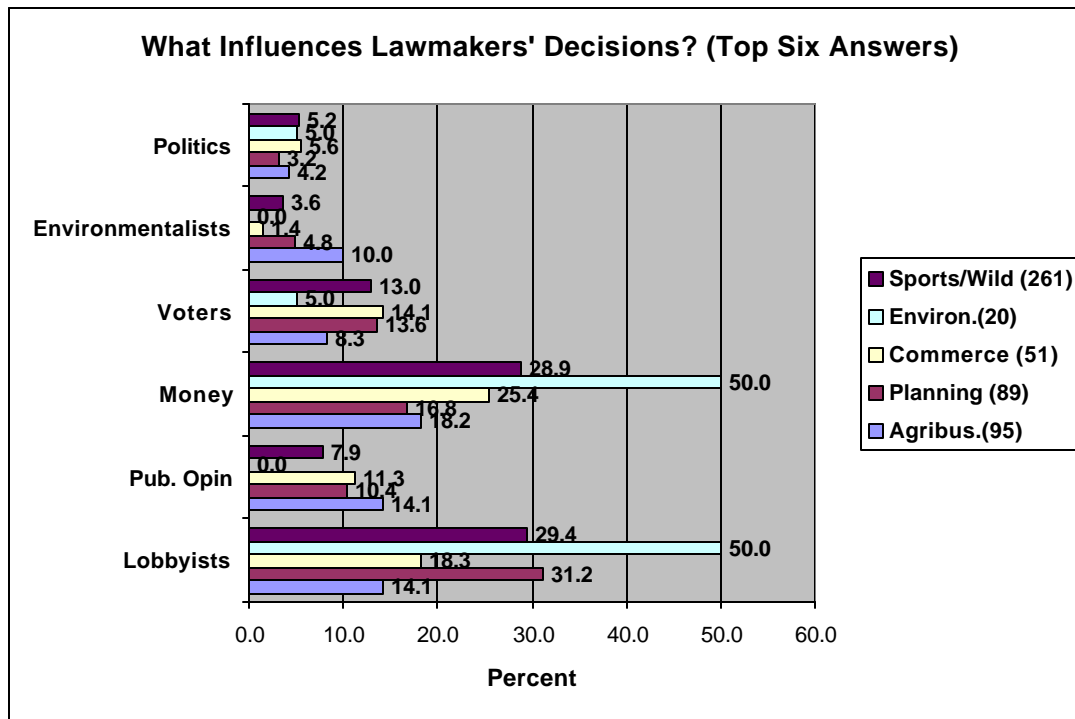
Figure 8. Opinions about Others' Knowledge. Only statements showing significant differences are graphed. p#05.

Respondents were asked to tell what they think influences lawmakers' decisions concerning animal operations. Approximately one-third 34.1% (n=516) of respondents said that lobbyists or PACs were the biggest influences. Other perceived influences were money or campaign contributions (32.2%), voters (17.1%), and public opinion (12.4%). These responses are further indicative of the distrust of lawmakers (or anyone) to make informed decisions on animal operations. Receiving notice from less than 10% of the respondents were influences such as mass media (5%), farmers/animal operators (3.9%), personal beliefs/experiences (3.1%) and personal friends/colleagues (2.3%). Even fewer respondents indicated reliable information (1.7%) as a factor influencing lawmakers' decisions. And, less than 1% of the

respondents said that concerns about public safety or general welfare of the people influenced decision makers.

Figure 9 shows, by group, the rate at which each group mentioned each of the top six responses to what influences law makers. The number in the parenthesis indicates how many individuals in each group responded to this question. The percent figures give the percent of the entire group for each response displayed. As can be seen, proportionately more respondents from environmental groups (50%) listed lobbyists or PACs (Political Action Committees) than did respondents from planning/development (31.2%), sports/wildlife groups (29.4%), commerce (18.3%) or agribusiness (14.1%). Likewise, proportionately more respondents from environmental groups (50%) said that money is what influences lawmakers decisions. They were followed by sports/wildlife respondents (28.9%), commerce group respondents (25.4%), agribusiness (18.2%) and then by planning/development respondents (16.8%). While voters as a source of influence was not high on any group's list, 14.1% of respondents from commerce, 13.6% from planning/development groups, 13% of the sports/wildlife respondents, 8.3% of the agribusiness respondents, and 5% of respondents from environmental groups thought that voters influence lawmakers' decisions. As can be seen in Figure 9, while environmental group members did not cite either public opinion or environmentalists as influential in lawmakers' decisions, small percentages of respondents from the other groups did. And, while "politics" as an influence in decision making among lawmakers was not frequently cited by any group, a little recognition was given to it as a force of influence. Overall, though, the respondents in this study put far more weight toward money and special interest groups than on the general welfare of the people or reliable information as influencing lawmakers' decision making.

Figure 9. Perceived Influences on Lawmakers' Decisions on Animal Agriculture.



Opinions About Policies

Respondents were asked various questions about their opinions on policies toward animal agriculture. Statements given to respondents were:

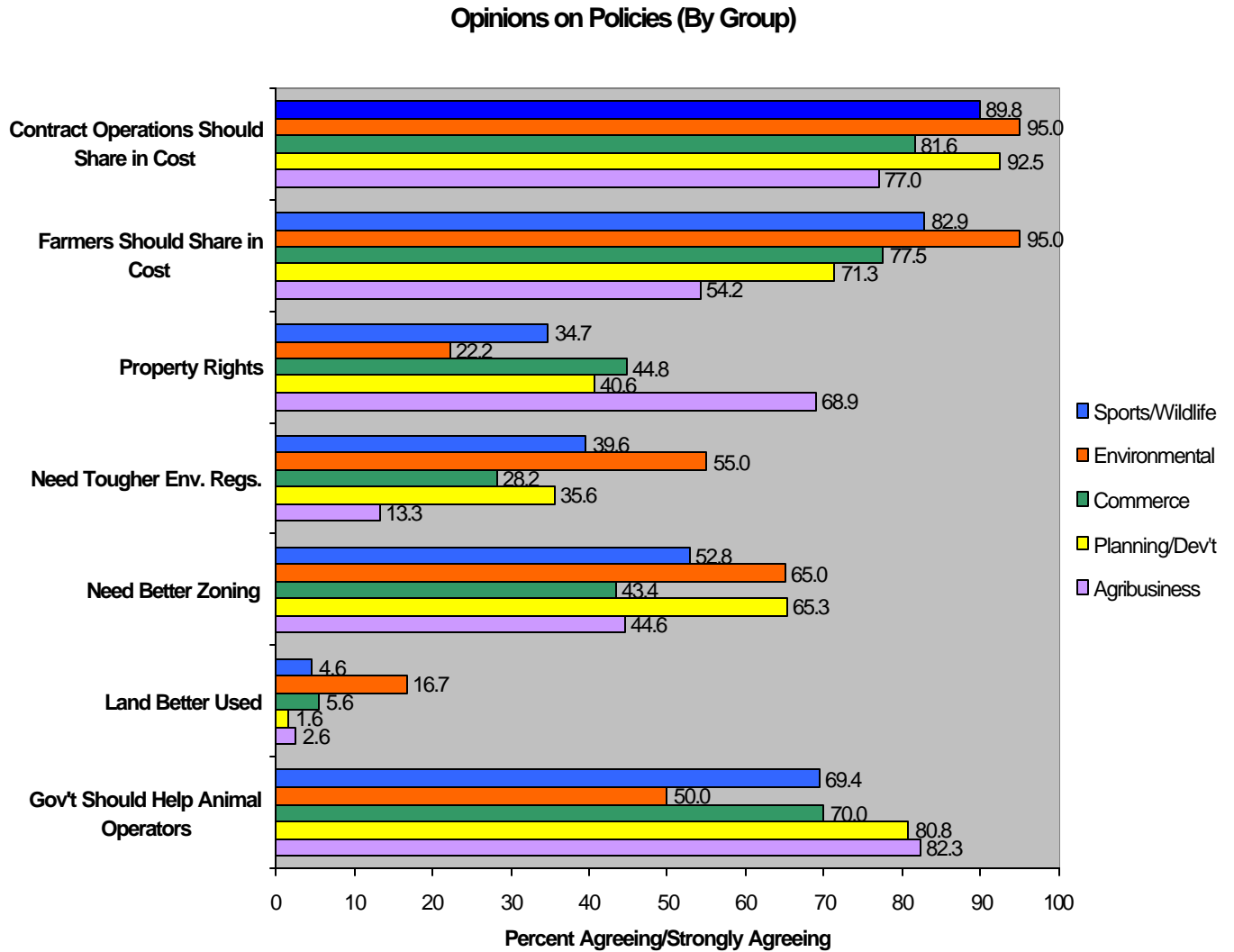
- “Contract operations (poultry and hog processors who contract with growers to produce animals for their processing plants) should share in the cost of cleaning up water contaminated by animal waste.”
- “Farmers should share in the cost of cleaning up water contaminated by animal waste.”
- “Property owners have the right to do with their property what they wish.”
- “We need tougher environmental regulations around animal operations.”
- “We need better zoning to separate animal operations from residential, business, and other areas.”
- “Land used for animal operations could be used for better purposes, such as residential, manufacturing, or business.”
- “Government policies should help animal operators because we need a reliable food supply here in the United States.”

Summary of Opinions on Policies

Figure 10 provides a breakdown by group of responses to questions about policies when there were significant differences found. Below is a quick summary of the findings on these items:

- Though there were significant (but small) differences among the groups, there was widespread agreement that contract operations should share in the cost of cleaning up water contaminated by animal waste. Over three-fourths of each group agreed.
- There also was widespread consensus concerning whether land used for animal operations could be used for better purposes. While a larger portion (16.7%) of the environmental group agreed than the others, there was still overwhelming disagreement to this statement among all groups.
- There also was agreement that farmers should share in the cost of cleaning up water contaminated by animal waste. However, in comparison with the other groups, much fewer (54.2%) of the agriculture group agreed.
- Likewise, there was general agreement that government policies should help animal operators. Only 50% of the environmental group agreed, however. This is somewhat interesting since when couched in terms of government helping family farms, the group's response pattern was quite different.
 - Concerning property rights, zoning, and the need for tougher environmental regulations, opinions between the groups sharply contrasted.
 - Over two-thirds (68.9%) of the agribusiness group agreed that property owners have a right to do with their property as they wish, while only 22.2% of the environmental group agreed. The other groups fell somewhere in between (34.7% of the sports/wildlife group, 44.8% among the commerce group, and 40.6% planning and development group).
 - A majority (55.0%) of the environmental group agreed that tougher environmental regulations are needed around animal operations, while only 13.3 percent of the agribusiness group agreed. Again, the other groups fell in between (39.6% of the sports/wildlife group, 28.2% of the commerce group, and 35.6% of the planning and development group).
 - Nearly two-thirds and of the environmental (65.0%) and the planning group (65.3%) and a majority (52.8%) of the sports and wildlife group agreed that better zoning is needed to separate animal operations from other activities. However, fewer respondents from the agribusiness (44.6%) and commerce groups (43.4%) agreed with this sentiment.

Figure 10. Opinions on Policies, By Group.



Only statements showing significant differences are graphed. p# .05.

Respondents were asked to discuss, in open-ended fashion, under what if any circumstances zoning or environmental regulations are justified. While the sentiment that individuals' rights to use their property as they see fit was well represented, one person said that we have to operate with the concept of "the greatest good for the greatest number of people." Several wrote essays to the effect that we have to give up some rights or compromise when this will result in more benefit to a community. Several respondents thought that encroachment from urban and exurban dwellers was creating a need for zoning. Several

respondents said that zoning and regulations are mechanisms we can use to protect the quality of life, protect farming as a way of life, protect the environment, and protect property values. Only one person declared zoning to be “communistic” and elaborated by stating, “*pin heads make the rules. I do not want pinheads telling me how to use my land. Government does not know how to regulate its property, so why should they regulate my property?*”

In open-ended commentary at the end of the survey and at the open-ended portion of the community concerns listing, several respondents indicated that sprawl (residential) is a serious problem in South Carolina. Several individuals commented that while leaders in the state have been calling this growth, it really is creating problems. Respondents indicated that farmlands need to be protected from sprawl, and that if a farm has been operating it should be allowed to continue operating (even if ownership changes hands) regardless of what is developed close to it. Several also said that while they are not opposed to family farms and farms in general, they are opposed to large and corporate operations. Several indicated a need to develop some type of zoning to take care of these various points of strain.

Community Concerns

Respondents were asked to rank how serious they thought an array of community concerns were for their community and its future. Each of these concerns was ranked as very serious, serious, don't know/not sure, somewhat serious, or not serious at all. Figure 11 shows the percent of respondents who answered “very serious” or “somewhat serious” for each concern. The most serious problems, according to the respondents, were crime (81.8%), drugs (80.8%), litter (66.1%), high taxes (57.4%), and teen pregnancy (55.7%). Many respondents also were concerned about population growth (50.7%), water quality (48.8%), residential sprawl (48.4%), and air pollution (46.9%). Based on these results, which are similar to the findings in the 1998 study, it seems that social problems are weighing more heavily on South Carolinians' minds than are problems associated with animal agriculture. However, it is noted that the groups polled in the current study seem to be relating a great deal of concern about water quality and air pollution.

Summary of Groups' Opinions on Community Problems

- The sharpest disagreements were over population growth, residential sprawl, and soil contamination.
- The environmental group (and, to a lesser extent, the sports/wildlife group) tended to put more emphasis on environmental and environmentally related issues than the other groups did.
- Concerning population growth, water quality, litter, and zoning, the opinions of the planning/development group seemed largely the same as those of the environmental and sports/wildlife group.

- Agribusiness seemed to agree with the environmental and sports/wildlife group about the seriousness of residential sprawl.

Figure 11. Community Concerns, Seen as Serious or Very Serious.

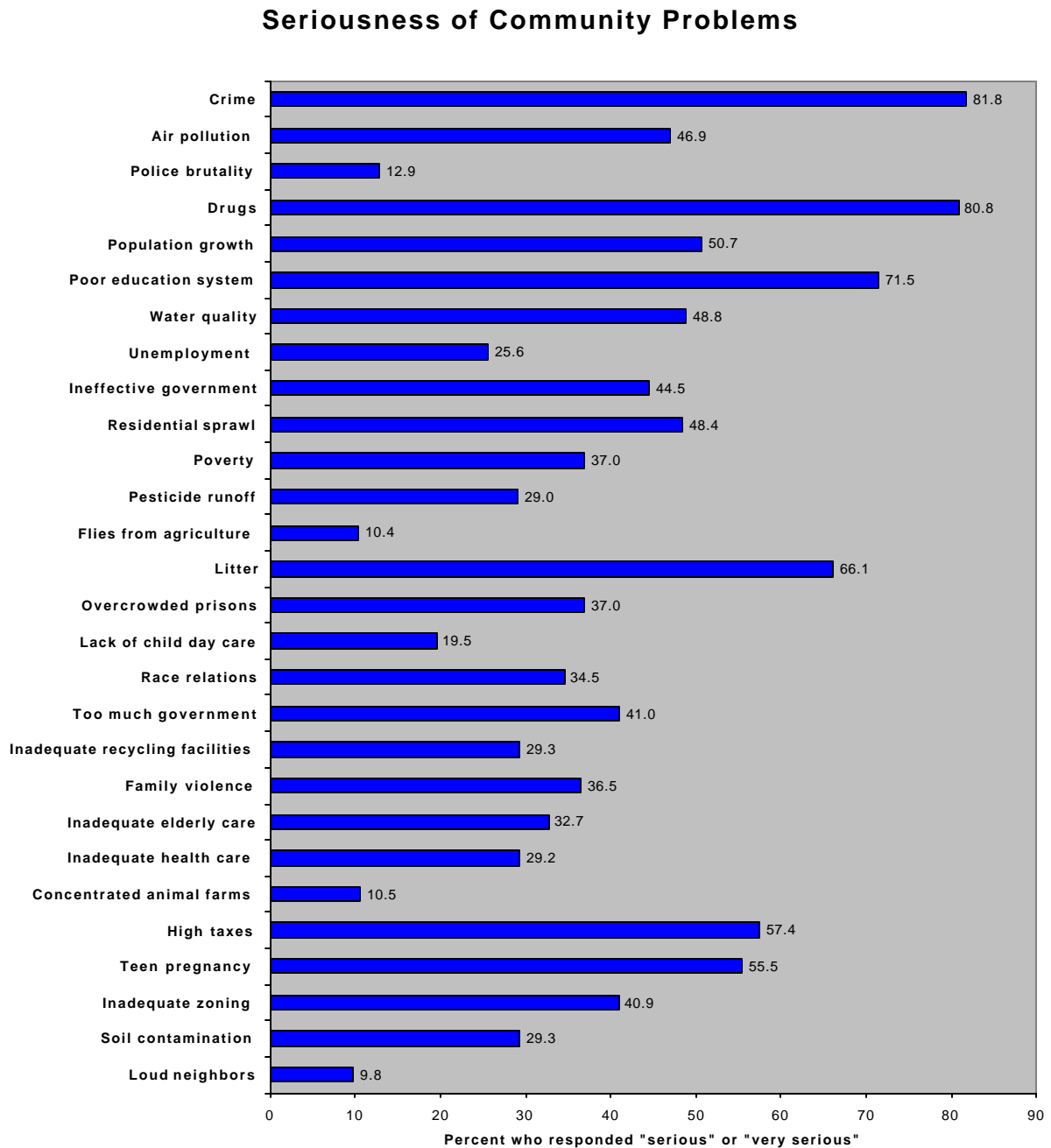
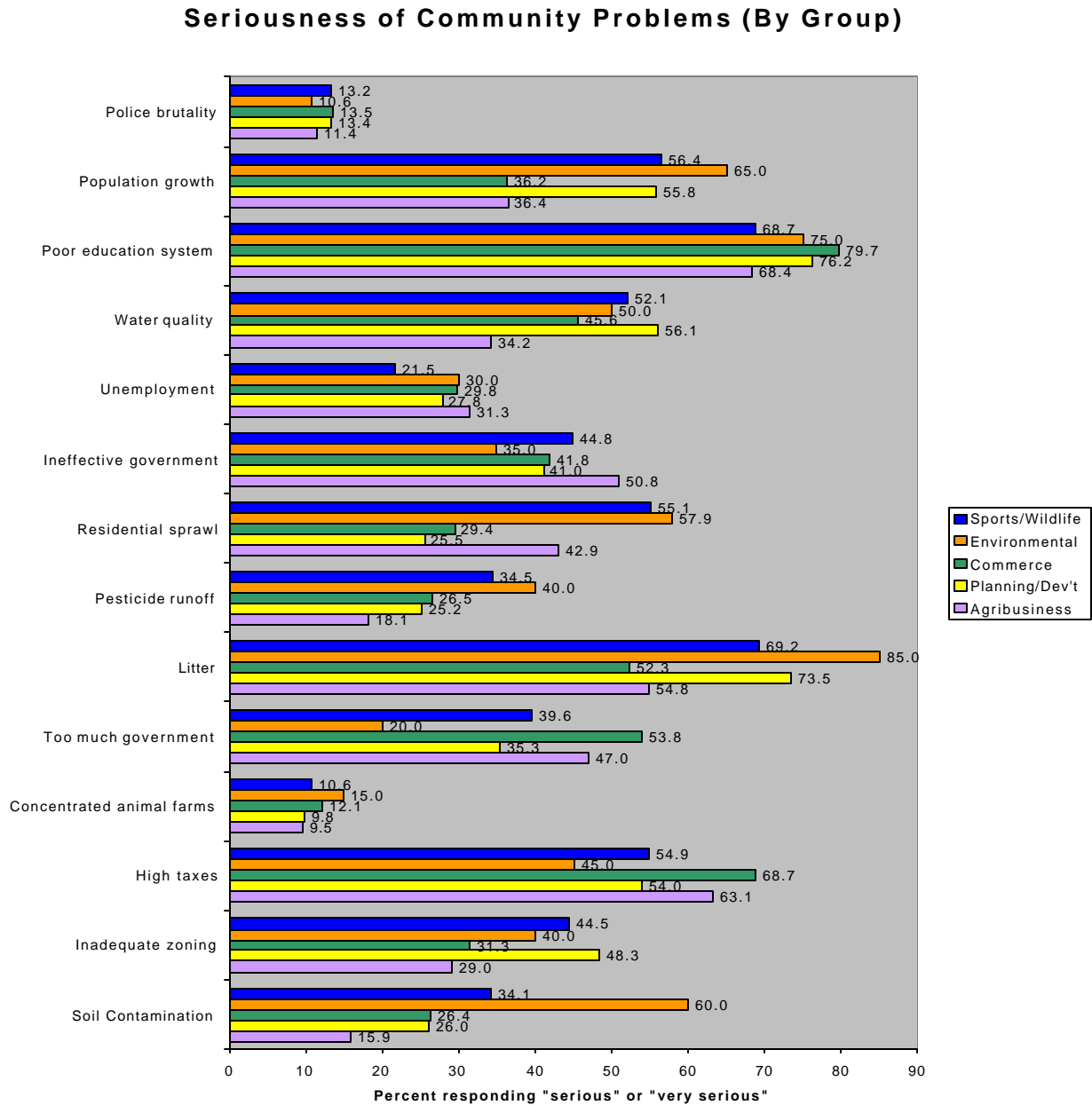


Figure 12 shows what percent of each group that responded “serious” or “very serious” for those community problems where there was a significant difference on opinions by group.

Figure 12. Seriousness of Community Problems, By Group.



Only statements showing significant differences are graphed. p#.05.

Closing Comments Made by Respondents

Many respondents wrote open-ended commentary at the conclusion of the survey. Many of these comments reiterated what they previously had written about regulation, zoning and social problems in the state. A few indicated that the leaders in their counties were incompetent or “jokes.” Several indicated that infrastructure maintenance is a problem in the state. Several also relayed stories of being affected by various types of encroachment spawned by lack of planning and zoning. Quite a few reiterated that farming is important (socially, economically) in the state. Some comments praised and others criticized the survey. Some wanted to know why the survey was being conducted and wanted to see the results published. Other comments included:

- *“Environmentalists know what the effect of farming is on ground/surface water. Need to work with farmers who are familiar with their agricultural processes to prevent or minimize impact. Government will have to work with both groups.”*
- *“Would like to see the community or communities of the county have community gardens so the families could have fresh vegetables, preferably organic gardens.”*
- *“The largest concern is the long term availability of good drinking water, then the pollution of oceans and streams which is creating a growing market for farm raised seafood, and of course the problem of air pollution...”*
- *“Please do not continue to let the Animal Agriculture departments at Clemson continue to dwindle away. We need educated farmers to meet the demands of a changing world.”*
- *“Farming in the U.S. is in trouble. Farming will move to less developed countries where labor is cheaper.”*
- *“I believe Clemson University should be a leader in the future of animal agriculture in the state of South Carolina and the state.”*
- *“I believe that before long all areas of agriculture will be performed under contract.”*
- *“I deeply distrust the implication that the government can or should help.”*
- *“I don’t feel that our growing urban population realizes the importance of animal agriculture, or any agriculture for that matter! There needs to be a constant awareness campaign.”*
- *“I hate to see SC become so urbanized and lose its historic farm connection. We need to do all we can to encourage Co-op farming in this state.”*
- *I have a University concern. Clemson University is not doing justice for the number of students in Animal Agriculture. We continue to lose professors with*

- increasing numbers. It sure looks like the process of phasing out AVS at Clemson is underway.”*
- *“I majored in sociology so I have great sympathy for farmers. More people cause more problems. We need more cooperation among people. May God help us!”*
 - *“I think we need areas for farms and livestock. We don’t need house after house, pavement everywhere. We need natural resources.”*

Conclusion

In light of the findings of the current study and those of the previous telephone survey, it appears that animal agriculture is basically in good stead with adults in South Carolina. However, issues such as zoning, regulation, property rights, ethical treatment of animals, responsibility for the environment, the preservation and support of family farms, the prohibition of corporate farms, and policy makers’ abilities to formulate well-reasoned policies about animal agriculture are issues that warrant reasoned public discourse.

An effort has been made in this report to highlight the “hot spots” that are revealed in this study, some of which were apparent in the 1998 study as well.

Based on these two studies, it would appear that South Carolina is a state experiencing a good deal of strain. That sprawl is occurring is documented by other studies. That people are strained by it has been revealed in this study. Farming as a way of life and family farming in particular are prized in South Carolina. However, whether residents are willing to pay the price to help it succeed is debatable. Furthermore, with sprawl encroaching on farm operations, public discourse about the implications of this sprawl, for individuals, the state, and the future, is necessary. This discourse necessarily must include zoning (or, land use planning), even though zoning is seen by some as a violation of property rights and as an unnecessary and unwelcome intrusion. To that end, dialogue is called for on property and individual rights, the common good, and the future of this growing state.

It appears that some respondents lack confidence in policy makers’ knowledge and abilities to pass and regulate well-reasoned policies about farming. Again, more public discussion about policies, how they are made, and who makes them and why, could be healthful for the state.

“Standpoints” became apparent while analyzing the data from the current study. In general, respondents agree that South Carolina has some major, serious social problems that are having negative effects on their communities. These include crime, residential sprawl, teen pregnancy, and air pollution. But, after that, divides appear. For instance, agribusiness does not see soil contamination and inadequate zoning as serious problems as much as do

the other groups. Fewer of those aligned with commerce rate high taxes and residential sprawl as serious than do the other groups.

This study and the one conducted in 1998 give support to the growing sentiment that in the name of quality of life in the state, and in order to reduce the strain due to changing patterns of life, increases in population, alterations in land use, several things need to be done. First, further examination into existing regulations surrounding animal agriculture, the rationale behind and efficacy of enforcement, should occur. Second, more and more citizens appear to believe that zoning, or regulated land use, is needed in this state. Already, newspapers are carrying stories of communities calling for zoning. Some of these local efforts are targeted toward keeping one particular element out of an area. For example, one push in some communities has been trying to restrict mobile home developments. Larger discussions are needed so that we think regionally and statewide vis-à-vis land use, population expansion, and accommodating an array of lifestyles and economic endeavors. As the land grant for South Carolina, Clemson University is an ideal vehicle for getting these issues that affect the state now, and will have permanent impact on its future, on the table and before the public.

Animal Agriculture and Watershed Impairment in South Carolina -A GIS-Based Spatial Assessment

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For a more complete discussion, see <http://www.strom.clemson.edu/publications.html>

ABSTRACT

Animal agricultural non-point source pollution remains one of the most challenging watershed problems. As reduction of the pollution becomes the top priority in the Clean Water Action Plan and states are required to implement the non-degradation policy, understanding the characteristics of animal agriculture, watershed impairment and their relationships at the state level are very important for making proper regulatory and management decisions. This research attempted to examine the relationships between animal agriculture and watershed impairment in South Carolina from a GIS-based spatial, empirical approach and to determine how strong the relationships are, which animals have larger impacts and where the problem areas are. It was found that 155 out of 274 watersheds in the 11-digit hydraulic units have been impaired by fecal coliform bacteria, phosphorus, dissolved oxygen, and pH problems, among which fecal coliform bacteria are the most widely spread problems in South Carolina. The results of both spatial and statistical analyses indicate that there are only very weak, though statistically significant, associations between animal agriculture and the impairments in this state. Cattle facilities appear to have slightly larger impacts on watershed quality than poultry farms do whereas swine operations are not a negative factor that aggravates the watershed impairment in this state. It is recommended that state policies on animal regulations and environmental standards should acknowledge the differences among impairment types, animal groups and geographic regions. More efforts should be made in control and reduction of pollution from cattle feeding operations especially in the areas with higher priority ranks and larger clusters of animal facilities that have been identified in this research.

KEY WORDS

Animal agriculture, watershed impairment, dissolved oxygen, fecal coliform, phosphorus, pH impairment.

INTRODUCTION

Animal agriculture has been perceived as a major source of pollutants. Over the past three decades, point source pollution has been largely controlled, but non-point source pollution from animal agricultural sources remains one of the most challenging national water quality problems. To provide “fishable and swimmable water” for all Americans, the Clean Water Act Plan (CWAP) prepared by USEPA and USDA and signed by the President has called for the enforcement of the Clean Water Act (as amended), improvement of environmental standards, and reduction of pollution from animal feeding operations. While more strict environmental policy may hinder the animal agricultural economy due to associated costs, the success of the plan depends largely on how well each state does its own job of pollution control, for more decisions are to be made at the state level as states are required to implement the non-degradation policy and take over more responsibilities from the federal government in daily operations of environmental control. It is therefore extremely important to approach impairment problems from a state perspective, examine their relationships with animal agriculture within a unique geographic unit, and provide reliable information for policy-makers and watershed managers to make appropriate decisions that not only comply with federal law but also promote states’ interests.

This research relies on GIS technology to map the distribution of animal agriculture, watershed impairment and their relationships using the 11-digit hydraulic units in South Carolina; it examines the spatial relationships between animal agriculture and watershed impairments through both spatial and statistical analyses; it intends to answer some critical questions such as what pollution problems are related to animals, how much animal agriculture has contributed to watershed impairment, which animals have relative significant impacts, and where the pollution problems exist.

Environmental Impacts of Animal Agriculture

Animal agriculture contributions to stream impairment consists of the pollution from animal wastes, the point source pollution from animal facilities or the non-point source pollution from the application of wastes and chemicals to fields. The pollution is characterized by excessive nutrients, harmful pathogens and undesired odors from animal wastes. The first two are closely related to watershed impairment problems. Although animal wastes or manure are useful for crop growing, excessive nutrients (nitrogen, phosphorus, carbon, potash, etc.) contained in the animal wastes that are washed into streams from animal facilities and sprayed fields may cause overgrowth of algae and changes in aquatic bioactivities that may deplete dissolved oxygen (DO) and alter pH values of waterbodies. The eutrofication phenomenon changes the living conditions of aquatic life and thus is a threat to aquatic species. Animal wastes also carry numerous pathogens which can be indicated by the presence of fecal coliform (FC) bacteria. Once released to waterbodies, these bacteria can cause human diseases and thus prohibit human recreational use of waterbodies. However, it is not an easy task to quantitatively evaluate

the impact of animal agriculture on watershed quality in a geographic area as large as a state due to the complexity of natural and human systems involved.

First, there are many natural and human factors that affect the movement and change of nutrients and pathogens in the geographically differentiated environment. Although laboratory tests can provide information about chemical compositions or types and amount of bacteria of specific animal wastes, it is hard to know what happens after animal wastes are released to waterbodies or applied in the fields. Experimental stations may be able to monitor conditions of streams adjacent to a few animal facilities, but it is difficult to determine the exact extents of a specific pollution in large areas. Second, nutrients and pathogens come from multiple sources including human wastes, urban runoff, and other agricultural activities in addition to animal wastes. It is thus extremely difficult to determine exactly which sources have been involved and how much they have contributed individually. Third, disparities and variations in natural environments also impose some obstacles for sampling and measuring watershed impairment on a consistent basis. Measurements taken at different time of the day, or season, or before or after a storm differ significantly. The same amount of nutrients may be considered excessive in one area but normal in another. All these uncertainties increase the risk in our decision-making in pollution control, especially when social and economic costs are considered. Failure to recognize the geographic differences in animal agriculture and associated pollution is one of the main reasons why we have failed to effectively control the non-point source pollution over the past three decades. Animal agriculture pollution is a geographical phenomenon and thus needs to be addressed from a spatial approach, particularly at the regional or state level.

Although there have been many studies dealing with animal pollution issues in South Carolina, few have taken a spatial, empirical approach. Most studies, like those conducted by Warner and colleagues (1998), have discussed the animal agricultural pollution in general terms without spatial consideration. The South Carolina Department of Health and Environmental Control (1997, 2000) continues updating the 303(d) list that contains information about the status of impaired waterbodies in the state, but makes no attempt to link these impaired waterbodies with animal feeding activities in watersheds. Allen, Lu and Blacklocke (1998) have examined the relationships between animal agriculture and impaired watersheds in the state from a GIS based spatial approach, but their research used the 8-digit hydraulic units for watershed impairment mapping. Such a resolution is too coarse to represent reality, and their assessment relied on visual interpretation of the maps without statistical analysis. There is a need to reexamine the relationships between watershed impairment and animal agriculture using finer geographic units and quantitative statistical analysis.

Objectives

This research revisited the animal agriculture-watershed impairment relationships from a spatial and empirical approach. There are four specific objectives to be obtained:

1. Map the watersheds impaired by DO, FC, P and pH problems in relation to animal agriculture as represented by cattle, poultry and swine in South Carolina in the 11-digit hydrologic units.
2. Examine the relationship between watershed impairment and animal agriculture using descriptive summary, canonical correlation, multiple regression, and Pearson correlation.
3. Identify the animal related factors that have significant impacts on the watershed impairment in concern.
4. Identify the problems areas that should be targeted for watershed management actions.

It was expected that this research would generate more detailed and accurate maps due to the use of much finer spatial units. It is also believed that compared to animal farm data aggregated at the zip code level, permitted animal facilities as a point coverage better spatially represent the distribution and concentration of animal agriculture in the state. The new releases of 1997 Census of Agriculture and the South Carolina 303(d) 2000 list also allow the researchers to update the previous study and provide new information. As new spatial data of watershed impairments have become available, it is possible to include phosphorus (P) and pH impairments in addition to dissolved oxygen and fecal coliform bacteria for a relatively comprehensive analysis. Turkey was also included in the poultry category due to their importance in the northern part of the state. Most importantly, a series of statistical analyses were designed to quantitatively examine the relationships between animal agriculture and watershed impairments in South Carolina.

METHODOLOGY

Data Preparation

Data were collected mainly for two purposes: mapping and analysis. The database built for this project mainly consists of three sets of source data related to watershed impairment, animal agriculture, and base map ancillary data.

Watershed Impairment Data

Watershed impairment in South Carolina was measured by dissolved phosphorus, fecal coliform bacteria, dissolved oxygen, and pH. These indicators were chosen mainly because they are: (1) among those closely related to animal wastes; (2) mainly caused by non-natural factors; and (3) prioritized for watershed management actions. Nitrogen was not used because non-point source nitrogen loads are significantly heavier from the atmosphere than from manure and fertilizer according to recent work completed by the U. S. Geological Survey's National Water Quality Assessment Program (Allen et al 1998).

The data source for these indicators is the list of 303(d) 2000 from the South Carolina Department of Health and Environment Committee (SCDHEC, 2000). SCDHEC utilized a point system for prioritizing the waterbodies on the South Carolina §303(d) list for

aquatic life and human health use impairment based on the severity of the water quality impairment and the impaired use of the waterbody. The process involved an evaluation of each water body for all of the following factors: potential impacts to endangered species, the severity of the pollution, the uses of the waterbodies, public support and, for waterbodies impaired by fecal coliform bacteria, the potential for primary contact recreation (swimming). Each impaired waterbody was given a priority ranking of 1, 2, or 3. The smaller the rank number is, the more serious the impairment is, and the higher the priority is for watershed management actions. It must be noted that priority rank is not exactly the same as impairment severity. The two terms were used interchangeably in this research because the former was treated as the normalization of the latter that minimized the differences and inconsistency of raw observation data. The 11-digit hydraulic codes attached in the list were used to relate the table to watershed coverage. To be consistent with the ranking system, the unranked waterbodies were assigned priority 4 for statistical analysis.

Animal Agriculture Data

Animal agriculture is represented by cattle (cow and beef), poultry (chickens and turkeys) and swine. Each was measured by nine variables, including animal population, animal farm counts, feeding facilities and animal units. The source data for the first three were extracted from the 1997 Census of Agriculture (USDA/NASS, 2000) and Animal Facility Permits in South Carolina (SCDEC, 2000). The 1997 Census of Agriculture is the most recent census available. In order to minimize the spatial error associated with data aggregation, this research used data aggregated at the smallest units, zip codes. It should be pointed out that counts of animal farms in the inventory are available from various sources but the animal population data at the zip code level can be obtained only through a special request. Permitted animal facilities were collected as a point feature with an attribute table attached. They were already in the GIS compatible format and so ready for analysis. Compared to those data extracted from the Census of Agriculture, facility data are much more accurate spatially and thus less error is expected during data processing.

Watershed Boundary Data

Watershed boundaries and other spatial data were also collected for GIS mapping and statistical analysis. The most important being the coverage of South Carolina 11-digit hydrologic units downloaded from the USGS web site. They were used as the units of study for both mapping and statistical analysis. All other spatial data were aggregated into these units during preprocessing. Zip code coverage was obtained from ESRI Data set (ESRI, 2000) and utilized as an intermediate spatial feature to relate the census data before all animal data were reaggregated into watershed units. Most ancillary data needed for base maps were the in-house data provided by the Spatial Analysis Lab, Strom Thurmond Institute of Government and Public Affairs, Clemson University.

Three main tasks were accomplished during the data preparation process. The first one was to convert all text files or irregular tables into the format that can be linked to geographic features. The second was to reaggregate impairment and animal data into

watershed units. And the last was to derive new variable data sets from existing coverages for conducting statistical analysis.

GIS Mapping

As in the previous project (Allen et al., 1999), this research took a watershed approach rather than a stream approach to mapping of water quality impairment caused by DO, FC, P and pH problems. The 11-digit hydrological units were used instead of the 8-digit units in order to improve spatial accuracy of the maps. There are four reasons for doing so. First, although the priority rank of each impaired waterbody was based on the observations from a site or sites along a stream, original point data do not contain complete information about where certain impairment starts upstream and where it ends downstream. Mapping impairment by streams, therefore, does not necessarily result in a better spatial accuracy. In fact the 11-digit hydraulic units are sufficient to show the spatial patterns of watersheds impairments at the state level. Second, from the perspective of watershed management, watersheds define the boundaries of possible sources of pollutants. It will help watershed managers to determine the causes of certain impairments by looking beyond a specific impaired stream. Third, for better visual effect, watersheds are polygons and thus, if shaded, more conspicuous than linear streams in maps. Finally, for the purpose of geostatistical analysis, it is easier or logically more sound to aggregate data onto watersheds than onto the stream segments.

The choropleth technique was used to map four types of the impairments. If there was one occurrence of impairment or one impaired site within a watershed, the whole watershed was considered impaired and assigned the value of the priority rank for that site. In the case that multiple sites were impaired, only the highest rank or most severe one was chosen as the representation for that watershed. It is admitted that this data aggregation resulted in loss of information and introduction of error, but the error was expected to be small as finer units of watersheds were used. In addition, the total number of impairment types were calculated for each individual watershed and mapped out accordingly to indicate where multiple impairment problems occur.

Mapping animal agriculture is straightforward once animal data have been aggregated for each watershed. It was intended to map only the most important indicators of animal agriculture, that is, animal population, farms, facilities and animal units for each animal group although other derived features such as various densities were also available in digital formats. They were also presented in choropleth maps in the 11-digit hydraulic units.

Differing from the previous mapping study, this research used permitted animal facilities to overlay with impaired watershed maps in order to show the spatial association between animal agriculture and polluted streams. Since animal feeding facilities are where animal agricultural activities take place and certain pollutants originate, the overlay maps should provide better visual presentation of the relations between the distribution and clusters of animal facilities and watershed impairments. For each type of impairment, three maps were generated for cattle, poultry, and swine respectively with each dot representing a facility site. A smaller size of dot was used for poultry facilities than for cattle and swine

facilities because of the abundance of poultry facilities. Even so, there are still many symbols stacked together too closely to be distinguished from one another. It is therefore not recommended to count the facilities based on these maps. But it is the coexistence of the facility clusters and impaired watersheds that help to reveal the association between animal agriculture and watershed quality.

ArcView 3.2 (ESRI) was used to *facilitate* spatial analysis and map-making process in this project. Avenue scripts were written for data summary, aggregation and clustering calculation.

SUMMARIES AND CONCLUSION

Summary of Major Findings

There are five major findings from this research. First, there is an association between animal agriculture and DO, FC, P, and pH impairment in South Carolina even though the strength of the relationship varies with the type of impairment involved and animal groups, and geographic areas or watersheds.

Second, the overall associations, no matter in terms of spatial overlaps, canonical correlation, multiple regression or Pearson correlation, are all very weak.

Third, it appears that cattle have slightly larger impacts whereas swine do not show any significant overlap with any types of impairments nor are they statistically associated with any of them. They are not an important factor that would aggravate the impairments in the state of South Carolina. Numbers of cattle facilities and poultry farms may be indicators of impaired watersheds while swine factors may be indicators of unimpaired watersheds.

Fourth, Fecal coliform bacteria are a pollution indicator that was the most widely spread in space and impaired 147 of 274 watersheds. The scarcity of P impairments implies that DO and pH impairment may have been caused by other nutrients and factors that may not be associated with animal agriculture. Finally, there are several watersheds that have been identified as problem areas with relative higher priority ranks and larger clusters of animal facilities.

Causes of Weak Associations

The results of map analysis, simple correlation, canonical correlation, and multiple regression all indicate that animal agriculture has some statistically significant effects on watershed impairment as measured by DO, FC, P or pH priority ranks. This may have resulted from animal regulations over the last three decades. There are also other explanations for these weak relationships.

First, there are multiple causes of DO, FC, P, and pH related pollutions other than animal manures. According Boering et al (1999), animal manure, for example, accounts for only 5% of nitrogen found in the streams in the area around the Gulf of Mexico. Both nutrients and fecal coliform can come from many other sources or human activities including industrial wastes, human wastes, urban runoff, chemical fertilizers of agriculture, golf courses, wildlife, and natural environments. It is possible that animal agricultures's share in the amount of variances in watershed priority ranks will become smaller even if all other factors are taken into considerations in the regression models.

Second, the incomplete data sets may not reveal the entire picture of the relationships between animal agriculture and watershed impairment. For example, the research used only phosphorus impairment data for analysis and other types nutrients such as nitrogen and potash were not included because they were not ranked as impairment problems in South Carolina. Research shows that a unit liveweight of cattle, poultry or swine generate more nitrogen than phosphorous in manure. A unit liveweight of cattle or swine also produces more potash than phosphorus. The nitrogen to phosphorus ratio may be changed in other areas unimpaired by phosphorus problems where close associations exist between nutrients and DO.

Third, due to the complexity of environmental systems and factors involved, the relationships between animal variables and watershed impairments are nonlinear. Both canonical correlation and multiple regression models used in this research are basically linear models and thus may not be appropriate for representing the reality that is chaotic in nature. Nevertheless, the analysis presented indicates that animal agriculture is not the major cause of watershed impairment in South Carolina.

Differentiations of Animal Impacts

Cattle agriculture appears to have a closer spatial correlation with the four impairment problems based on the spatial and statistical analyses. This can be explained in the following ways. First of all, cattle have the highest average animal units per facility and per farm among the three animal groups. Per facility or farm wastes are also high and correspondingly so are the pollutants. In addition, cattle have the highest degree of concentrations in facilities and the cumulative impact is relative large. Furthermore, most cattle facilities, especially those that coexist with impaired watersheds, are located in the west and northwest regions where slope is relatively steeper than the coastal areas. Animal wastes from cattle facilities or animal manure that were applied to the fields may be more easily washed into streams by runoff.

It is surprising that the number of poultry farms, not the number of poultry facilities or animal units, was found to be a better indicator of watershed impairment on several occasions. This may be because the capacity of each poultry facility is relative small though the total number is large. The average animal units per facility are very small compared to those for cattle. Poultry farms, on the other hand, including only those whose annual sale of animal products are greater than one thousand dollars, are relatively large. The wastes generated per farm are more than those per facility. However, several watersheds with the largest clusters of poultry facilities are not impaired by any of the

four problems, suggesting that larger facilities may have better waste management plans or measures.

There are also three factors that help to explain why swine operations are not a negative factor in watershed impairment. First, swine population is the smallest among three animal groups, so are the equivalent total animal units. Everything else being equal, the impact of the swine population should be the smallest. Next, most swine are raised within facilities which are often better equipped for waste management. Implementation of animal facility permitting systems also has had some positive effect. Lastly, most swine operations are located in the interior areas of the flat coastal plain region where soil erosion and runoff are relatively low, though the areas are prone to storm surges.

It is noted that animal population or animal units were not found to be a significant variable in canonical correlation or in the regression models. This is different from what was expected because animal wastes, which are a function of animal population or animal weights, are the real sources of pollutants. If the finding correctly reflects the reality, continuing growth of animal populations or animal the agricultural economy should not be considered a threat to the environment. Efforts in controlling animal related pollution should focus on aspects of animal waste operations.

Distribution of Problems Areas

From the maps generated in this research, one can identify the problem areas such as watersheds impaired DO, FC, P or pH problems, watersheds with serious impairment, watersheds with multiple pollution problems, watersheds with pollution probably caused by animal operations, or areas with any combinations. What is worth further discussing is those closely related to animal agriculture.

At the 5-digit level, impairment problems prevail in the Saluda-Wateree-Santee system whereas no serious animal-related pollution problems in the Savannah River system. At the 8-digit level, three major concentration areas can be found in the Saluda, Lower Catawba-Wateree and Lake Marion watersheds. They are not the largest agricultural areas in terms of either animal operations or crop production. This leaves researchers to speculate about the true causes of watershed impairment in these areas. Industries such as old textile mills along the Saluda and Wateree rivers, upstream urban centers such as Greenville, Spartanburg, Greenwood, Rock Hill, Charlotte and Columbia, and intensive recreational uses of streams flowing into Lake Murray, Lake Marion and Lake Moultrie, may have more impact on water quality in the areas than does animal agriculture. A map with human population overlaid on the FC impaired watersheds indicates that there is strong spatial correlation between the two.

However, animal agriculture is likely responsible for a few regional or local watershed impairments, particularly in the watershed right above Lake Murray. This watershed has the largest cluster of cattle facilities and cattle units, the top 8 largest clusters of poultry facilities and the top 15 swine animal units. All together these make the watershed rank third in total animal units in the state. Furthermore, this watershed has one of the largest

areas of cropland in upstate South Carolina where animal wastes are commonly applied to the crop fields for fertilization. It is assumed that large amounts of excessive nutrients and bacteria carrying wastes have been washed into waterbodies mainly through the surface flow and therefore contribute to multiple pollution problems. More regional or local scale research is needed for identifying and isolating the true causes.

Limitations of the Study

Although the research has provided spatial and qualitative analyses with better data, it cannot for certain determine the exact cause-effect relationships. The non-linearity or chaotic nature of complex human and natural systems cannot be fully represented by any statistical or mathematic models. One single pollution event may cause serious problems in other geographic areas and may vary over regions and over time. This is extremely difficult to integrate into a statistical model.

Due to the inconsistency in scales and units of spatial data, data has to be aggregated in the watershed units for mapping and statistical analyses. This process introduces errors and adds some uncertainties to the findings. Original data from the census of agriculture are also notorious for errors and thus its reliability is questionable. Animal facility permits, which were collected for purposes other than the analysis presented here, are relatively good at providing locations but do not have items that can be used for a comprehensive analysis.

It is admitted that no study would be considered complete if variables representing other human systems and natural systems are excluded in the research. The relationships revealed in this research may have been different if other variables were taken into equations. As for animal agriculture, variables such as size of farms, facility capacities and others were not considered. Certain spatial variables that reflect spatial patterns of each feature and its relationships with other locations and other features were either not available or not included; and interaction terms were not included. Time and financial resources also limited the amount of variables included in the study.

Implications

The findings of this research have several important policy implications in environmental protection and watershed management.

First, because there is a statistical relationship between animal agriculture and watershed impairment, animal agricultural factors should be taken into consideration in policy-making at the state level. This makes it necessary to continue regulate animal facilities and agricultural practices for better environmental quality. Although the relationship is very weak, certain regulations and best management practices will always be necessary to protect rivers and streams.

Second, since there is only a very weak relationship between animal agriculture and watershed impairment, it would be wise to continue searching for and target the more important causes of watershed pollution. Animal variables as a whole explained at

maximum about 25% of the variance in priority rank scores. This not only indicates that animal agriculture is not the major factor that affects water quality but also strongly suggests that other factors may be primary causes of the impairment problems. For more effective watershed management with limited resources, state agencies should make more effort in identifying and controlling other human activities that are most likely contributing to watershed impairment.

Third, fecal coliform impairment is the most serious one among all four types of impairments studied in many aspects and thus should be a priority for management actions. More than half of the watersheds in the state have FC problems; there are more watersheds with the top and second rank for FC than any other impairment. Furthermore, FC impairment is the one that most threatens human use of water. It also ranked second next to phosphorus in terms of total variance explained by animal variables. Phosphorus impairment appears to be a local or regional problem. Phosphorus, the only nutrient ranked and studied, may need to be targeted for environmental control related to animal agriculture. DO and pH are secondary or indirect impacts of excessive nutrients released to the waterbodies. Their true causes should be identified before proper action is taken.

Fourth, it suggests, that more attention may need to be paid to cattle than to swine if animal groups are to be differentiated for regulatory management targeting. Although it is difficult to differentiate the effects of animal agriculture between animal groups and across impairment types because of weak relationships, cattle was found to a slightly higher contributor of the current impairments. In contrast, swine are not accountable for the observed problems in South Carolina. Nonetheless, it should be emphasized that, as in North Carolina, most swine facilities are located in the coastal regions that are prone to natural disasters such hurricanes. While cattle livestock should be targeted for possible action in pollution mitigation, strategic disaster management plans may need to be implemented for swine facility operations to ensure environmental protection.

Finally, it appears appropriate to have spatially differentiated watershed management plans if a similar polity is not possible. Although the 303(d) list for 2000 has prioritized the watersheds for individual impairment, areas with multiple problems, higher priority ranks, and more severe pollution should be targeted first. These areas are identifiable from the maps generated in the project and additional information about them can also be easily extracted from the GIS database. As for an animal agriculture-oriented watershed management plan, watersheds in the Saluda River Basin above Lake Murray should be the focus of management efforts and future research because that is where multiple impairment problems are overlapped and different animal facilities are highly clustered.

Conclusions

The relationship between watershed impairment and animal agriculture is very complicated in nature because so many factors are involved and constantly changing over time and space. This research has attempted to examine the relationship from a spatial, macro, and empirical approach with a hope of generating information useful for policymaking at the state level. Although 155 11-digit watersheds have been found impaired by DO, FC, P and/or pH problems, there is only a very weak association

between these types of watershed impairments and indicators of animal agriculture based on the empirical analysis. The findings may not truthfully reflect the reality due to data constraints, inappropriate variables, or simplified models, but it would be unwise to ignore the impact of animal agriculture or relax any existing regulation due to the nature of the problem. So would it be disastrous to target animal agriculture as the sole cause of DO, FC, P and pH problems, for other factors account for 75- 85% of the variances in priority rank scores and are left out of the equation. To fully understand the causes of watershed impairments, scientists should not only continue to search for better animal agriculture variables and conduct analyses using finer spatial units, but also attempt to incorporate all possible factors (natural, human, and animal) into models and take catastrophic events into consideration in their future research. Most importantly, state policies on animal regulations and environmental standards should acknowledge the differences among impairment types, animal groups and geographic regions. More efforts should be made in control and reduction of pollution from cattle feeding operations especially in the areas with higher priority ranks and larger clusters of animal facilities that have been identified through this research. We may not be immune from all negative environmental impacts due to incompatible activities, but we can avoid the worst scenarios with informed and wise decisions.

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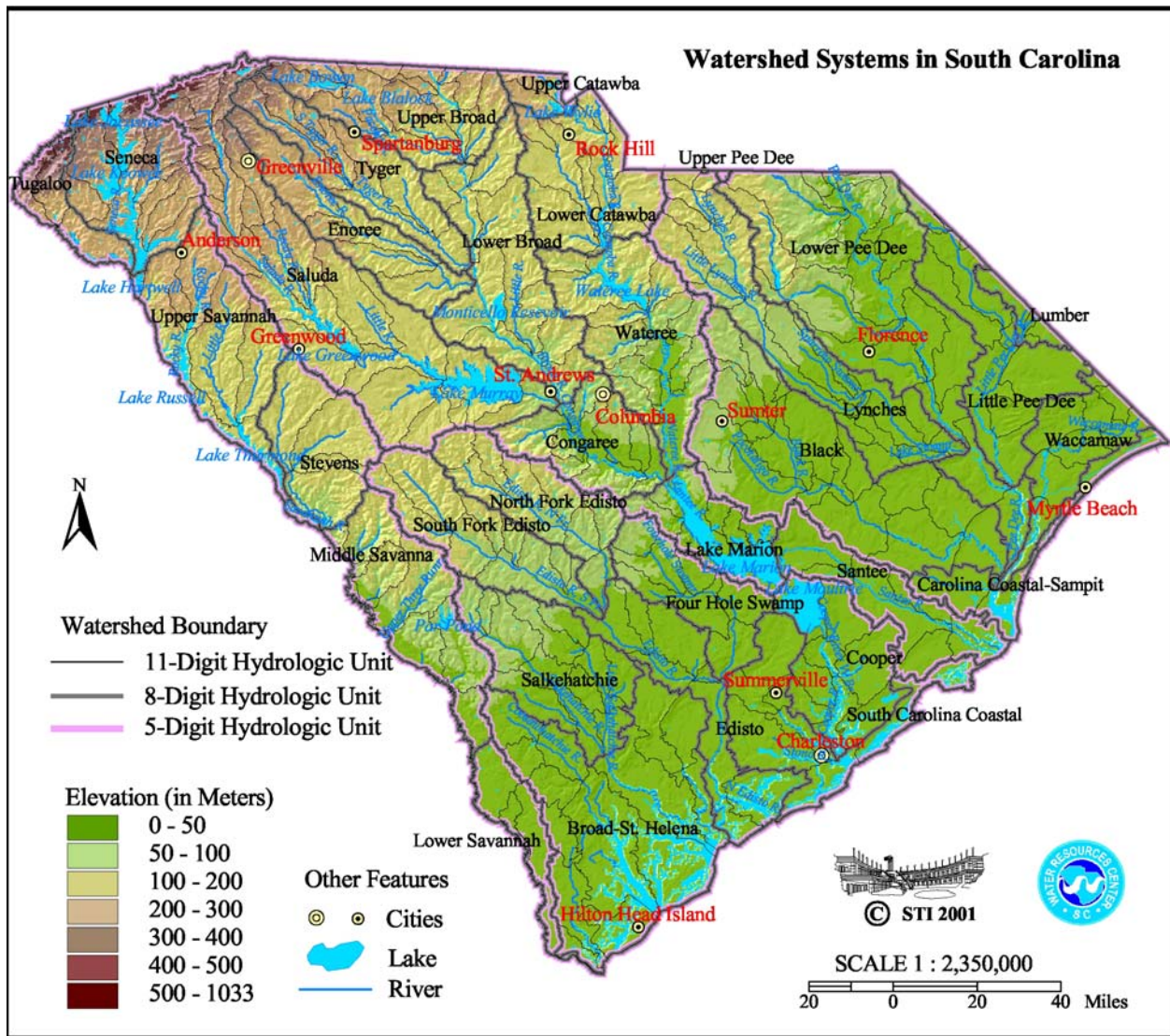
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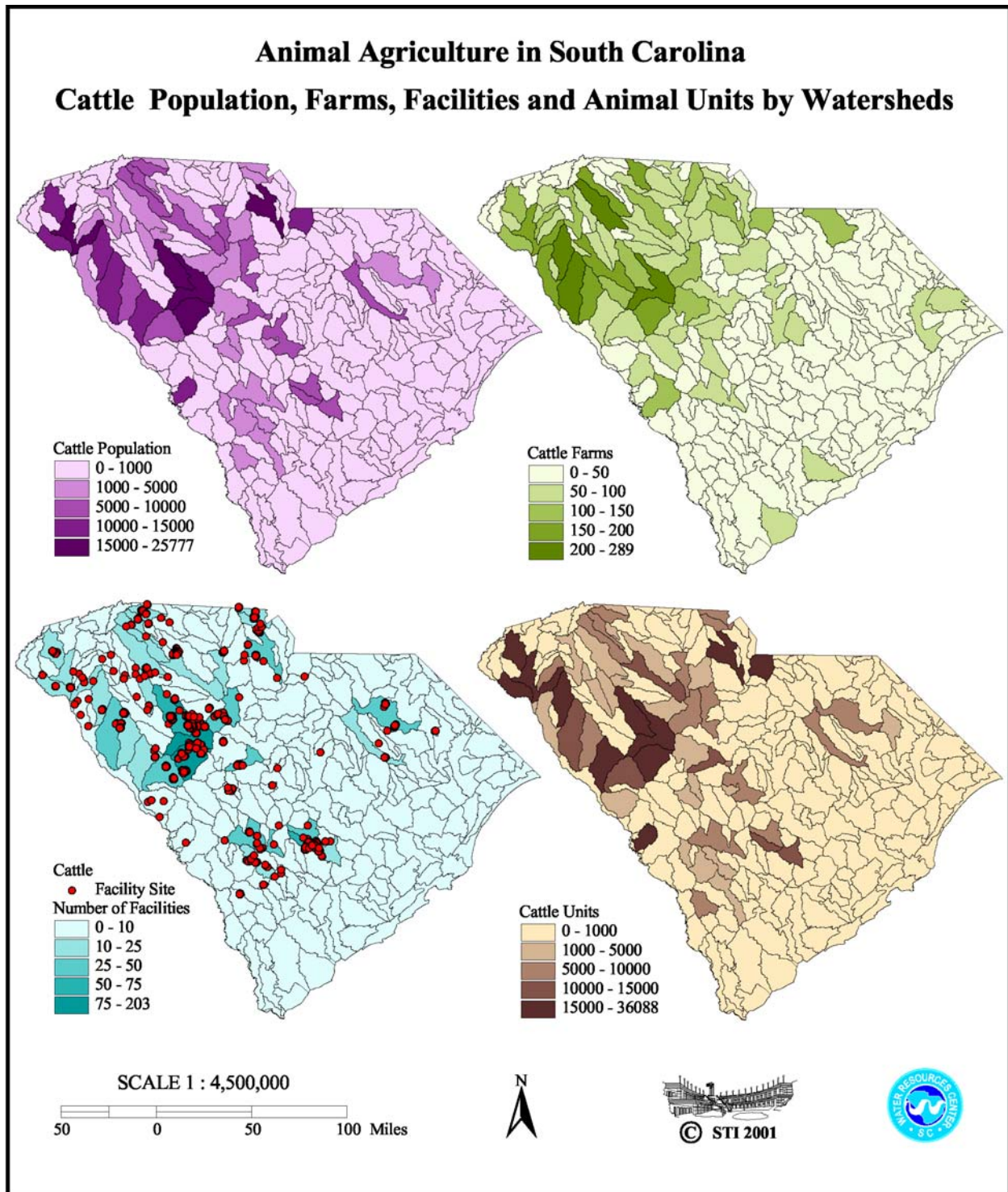
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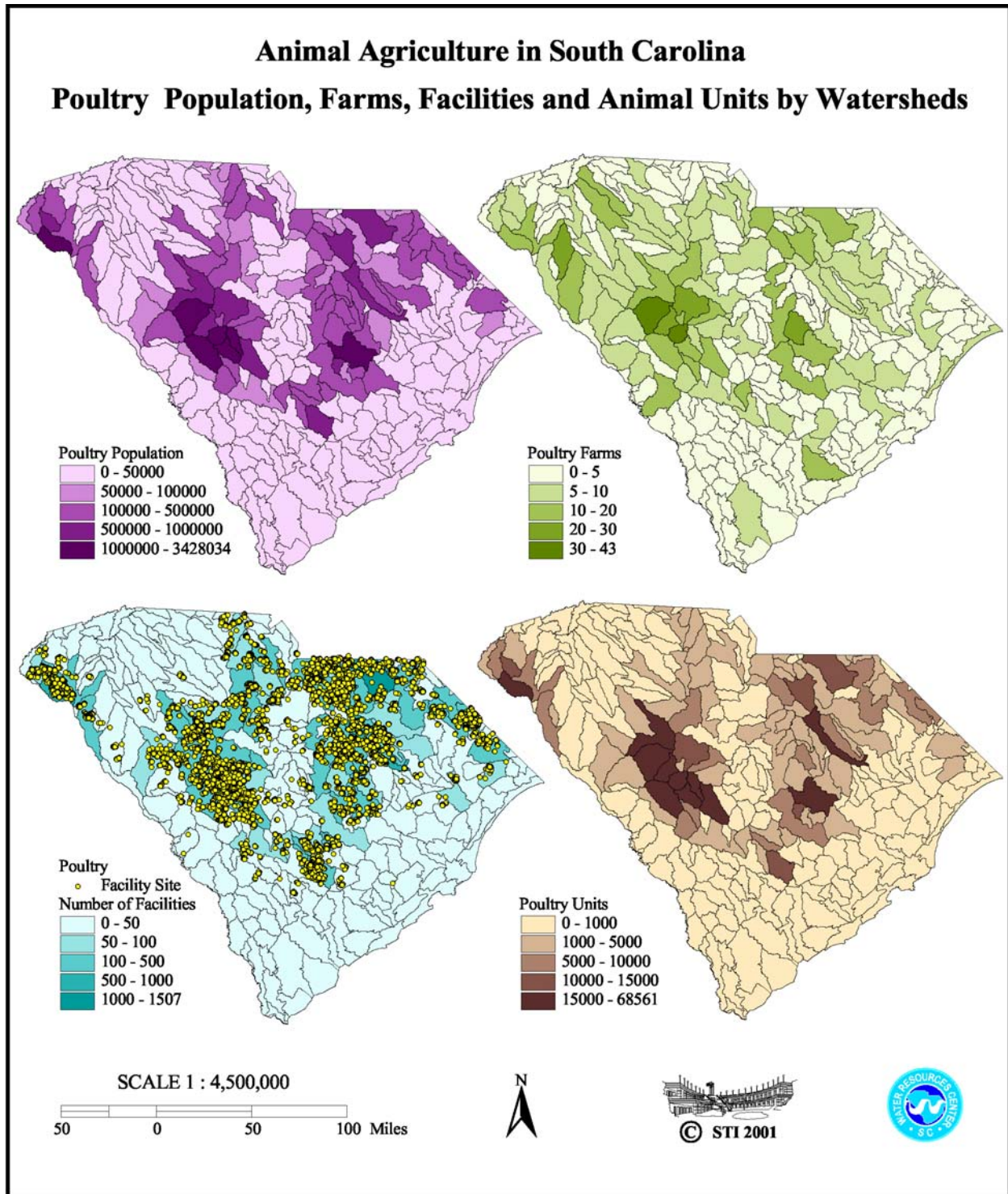
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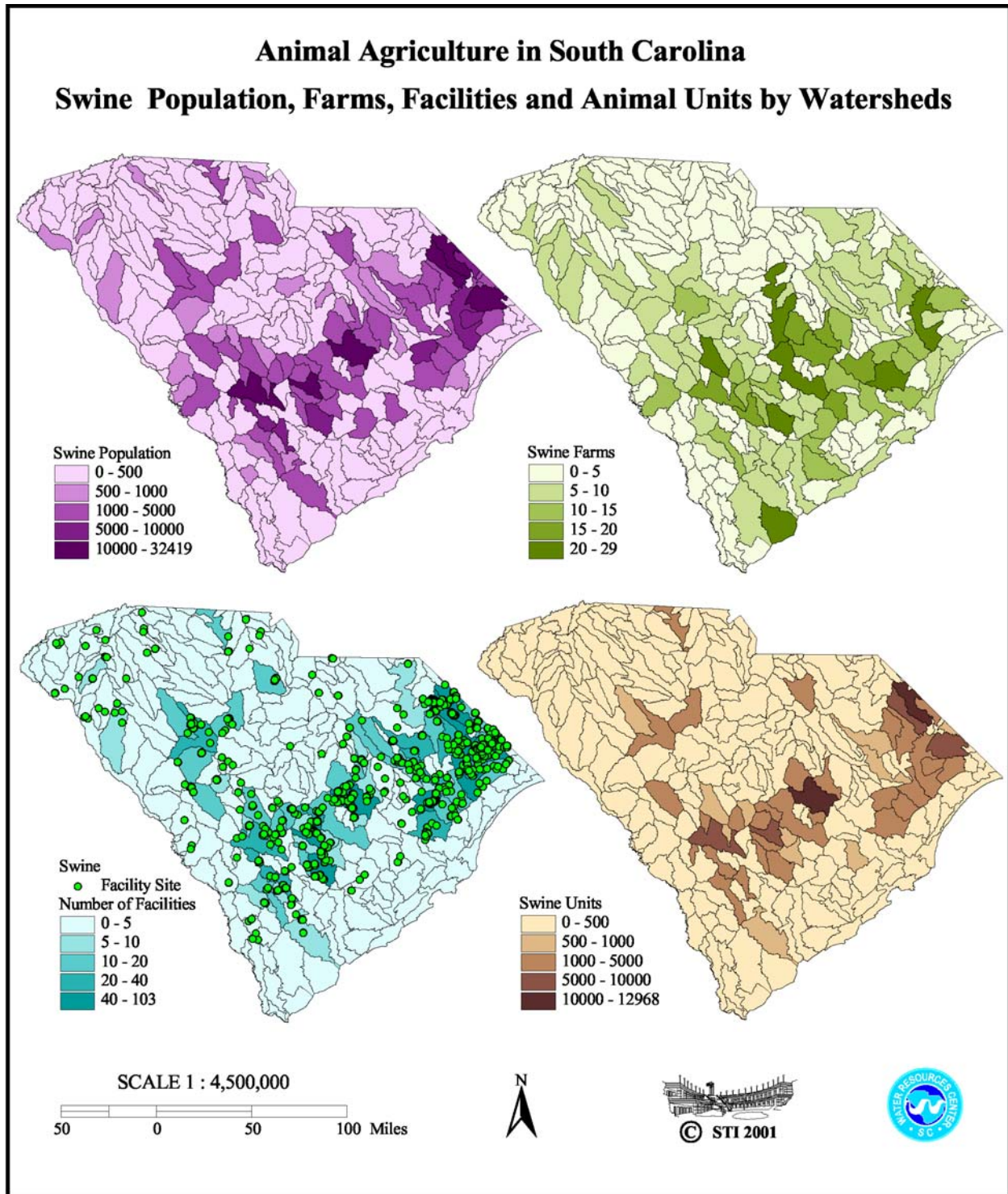
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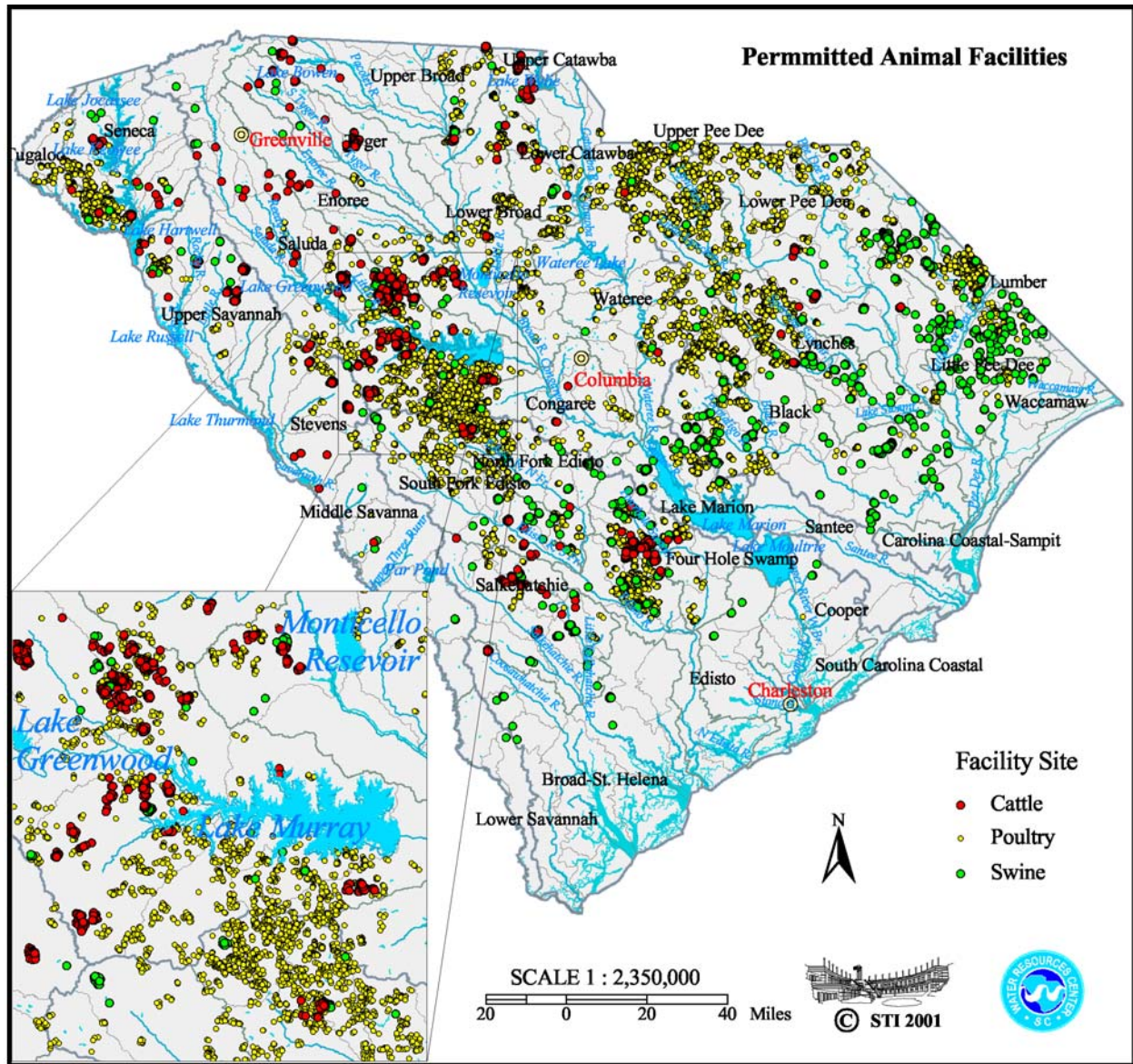
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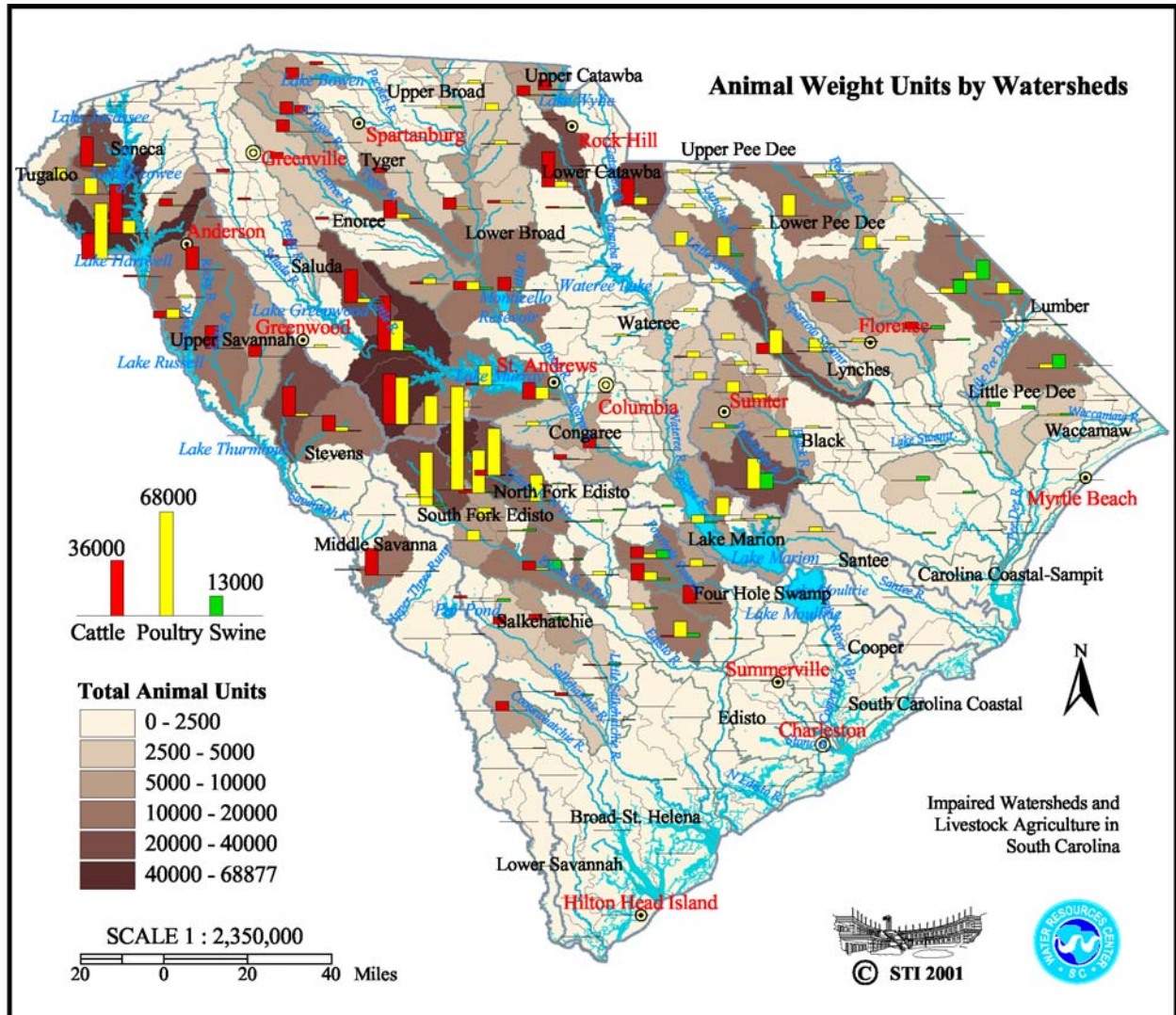
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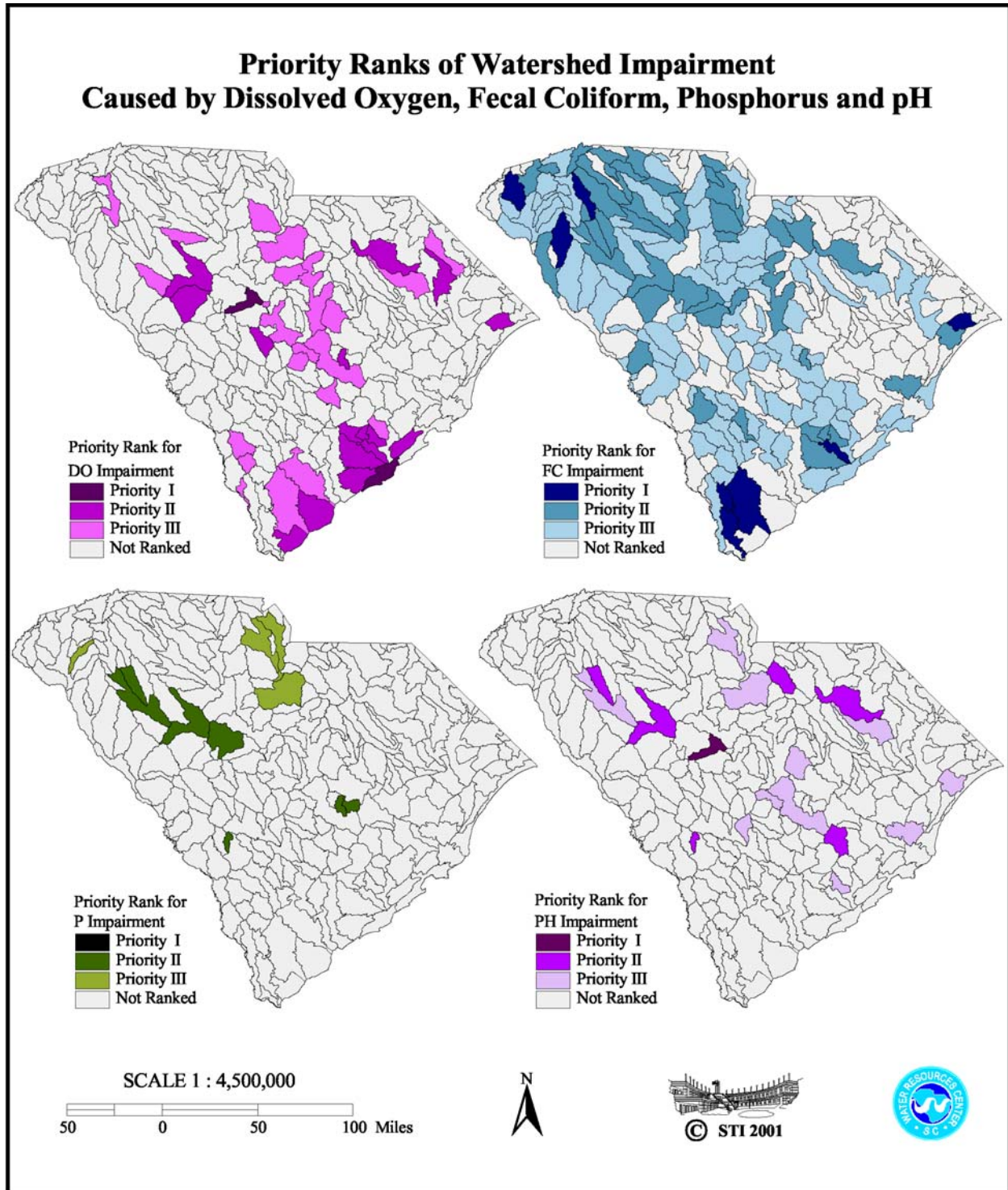
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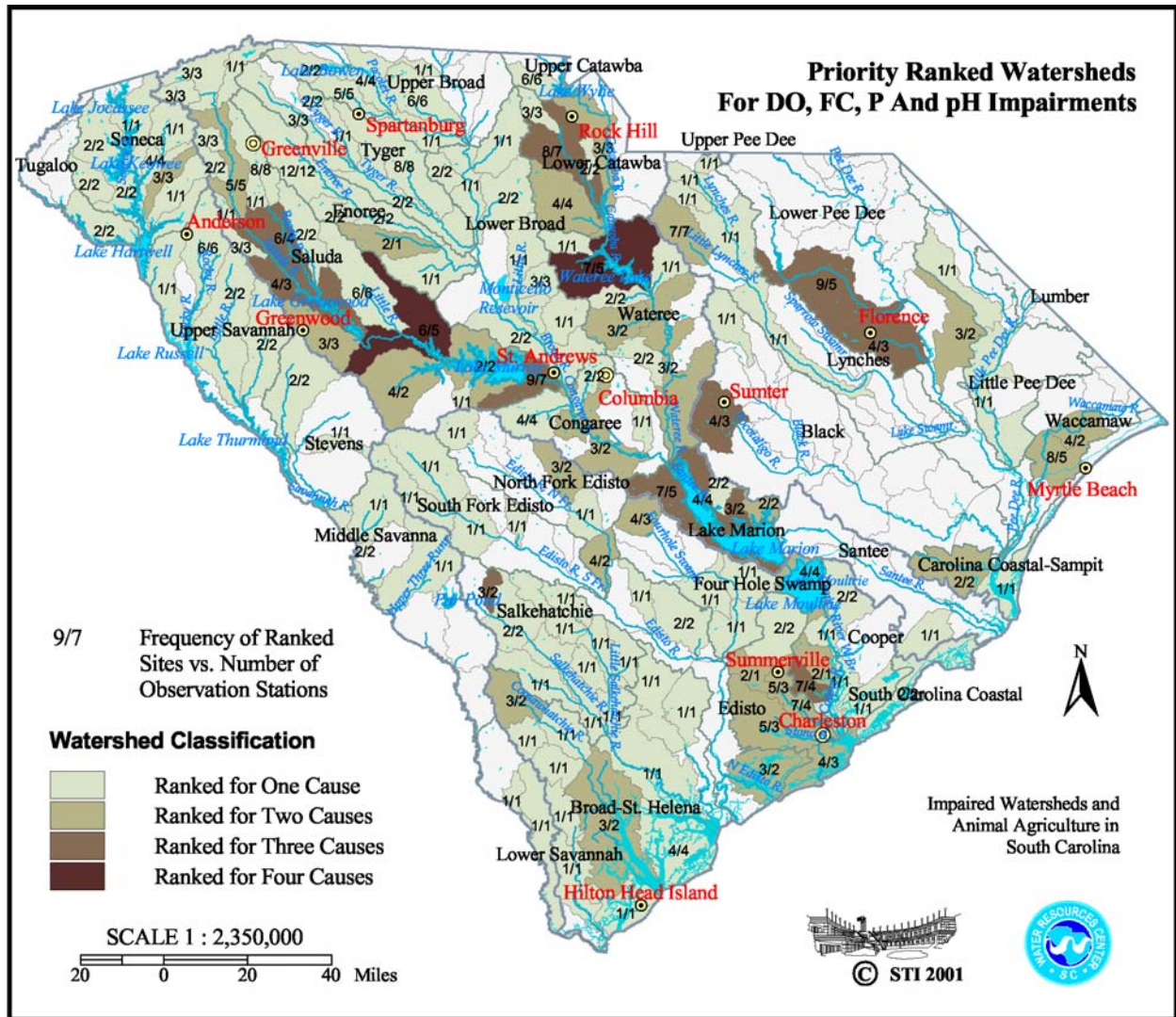
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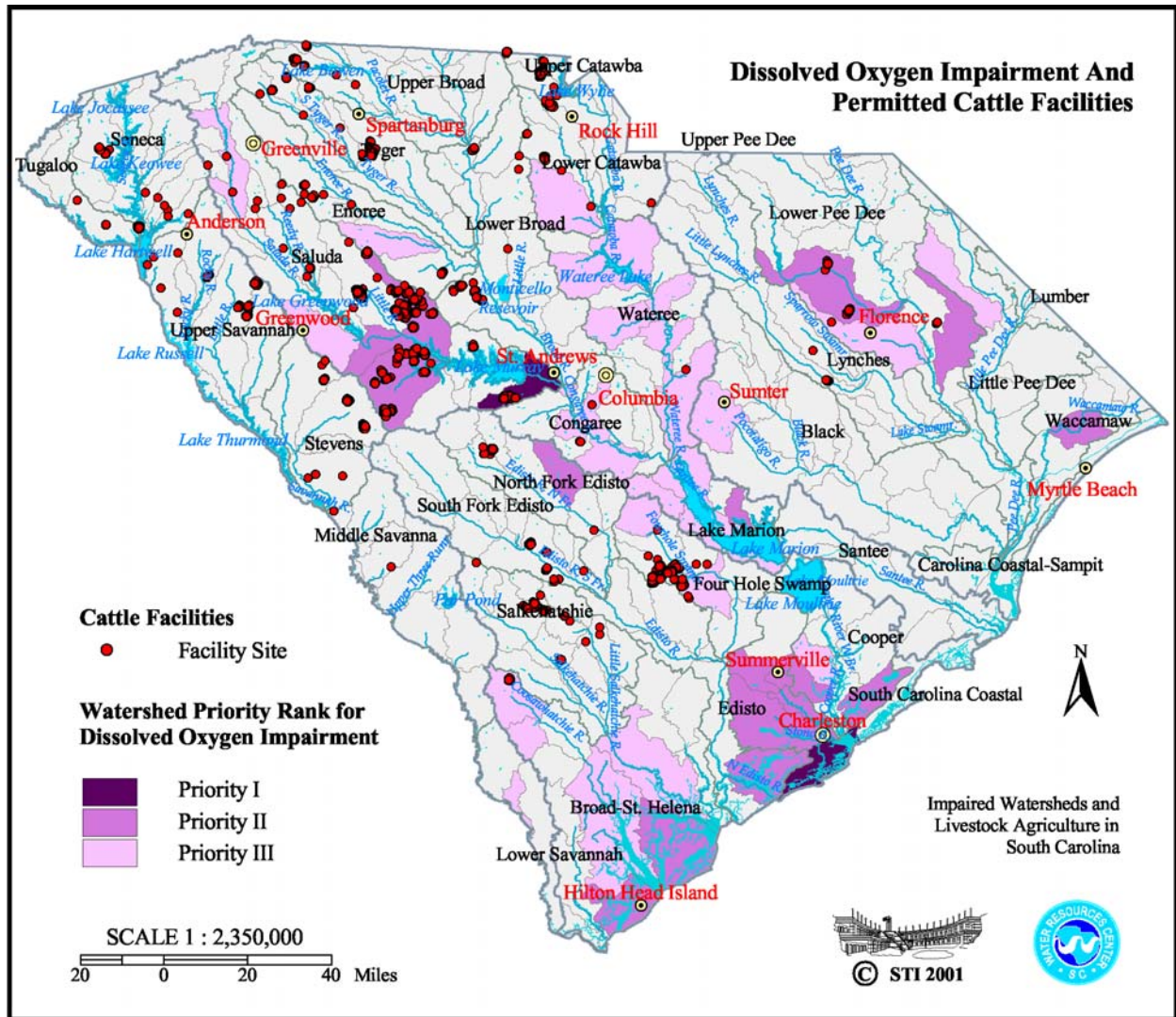
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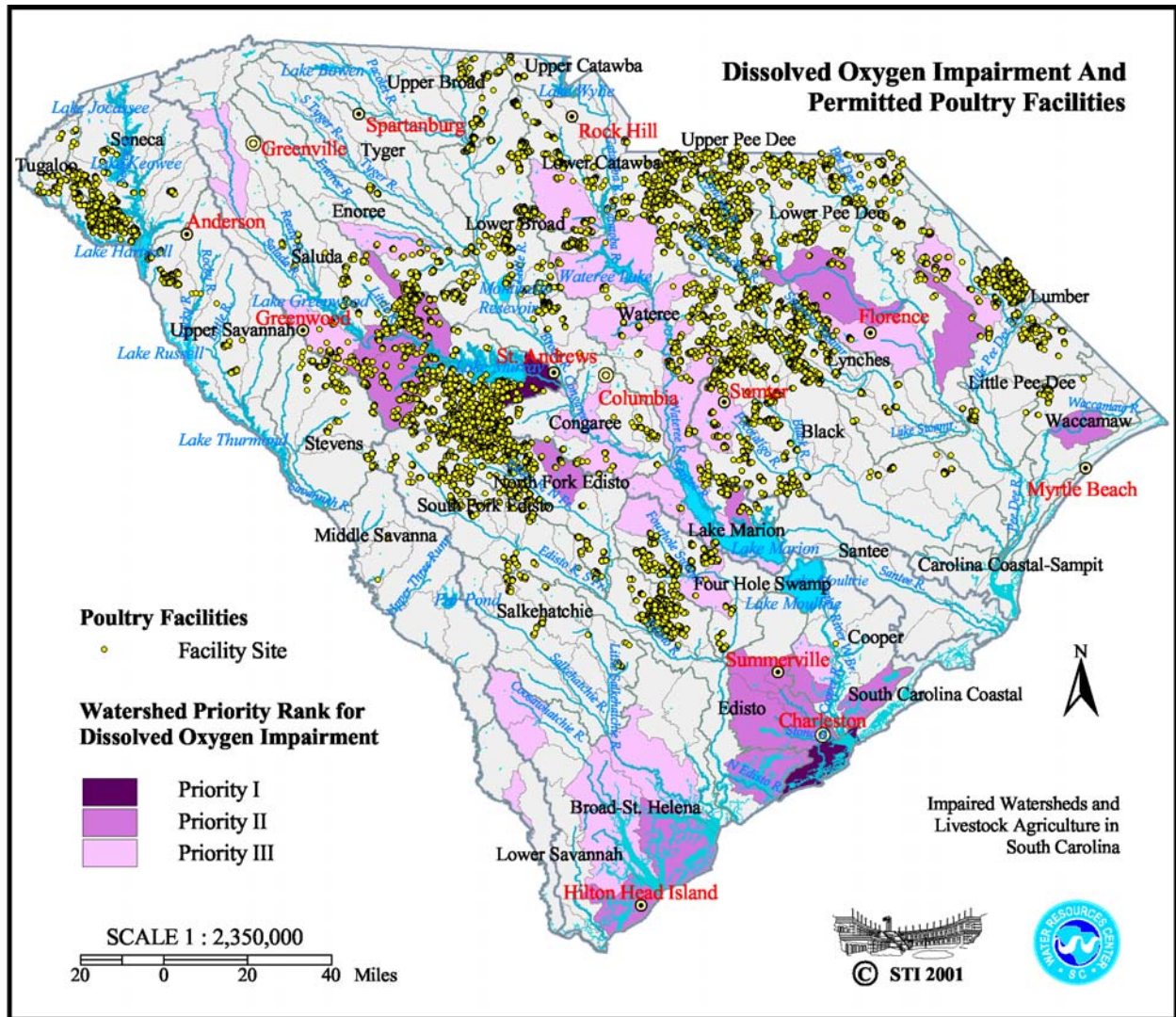
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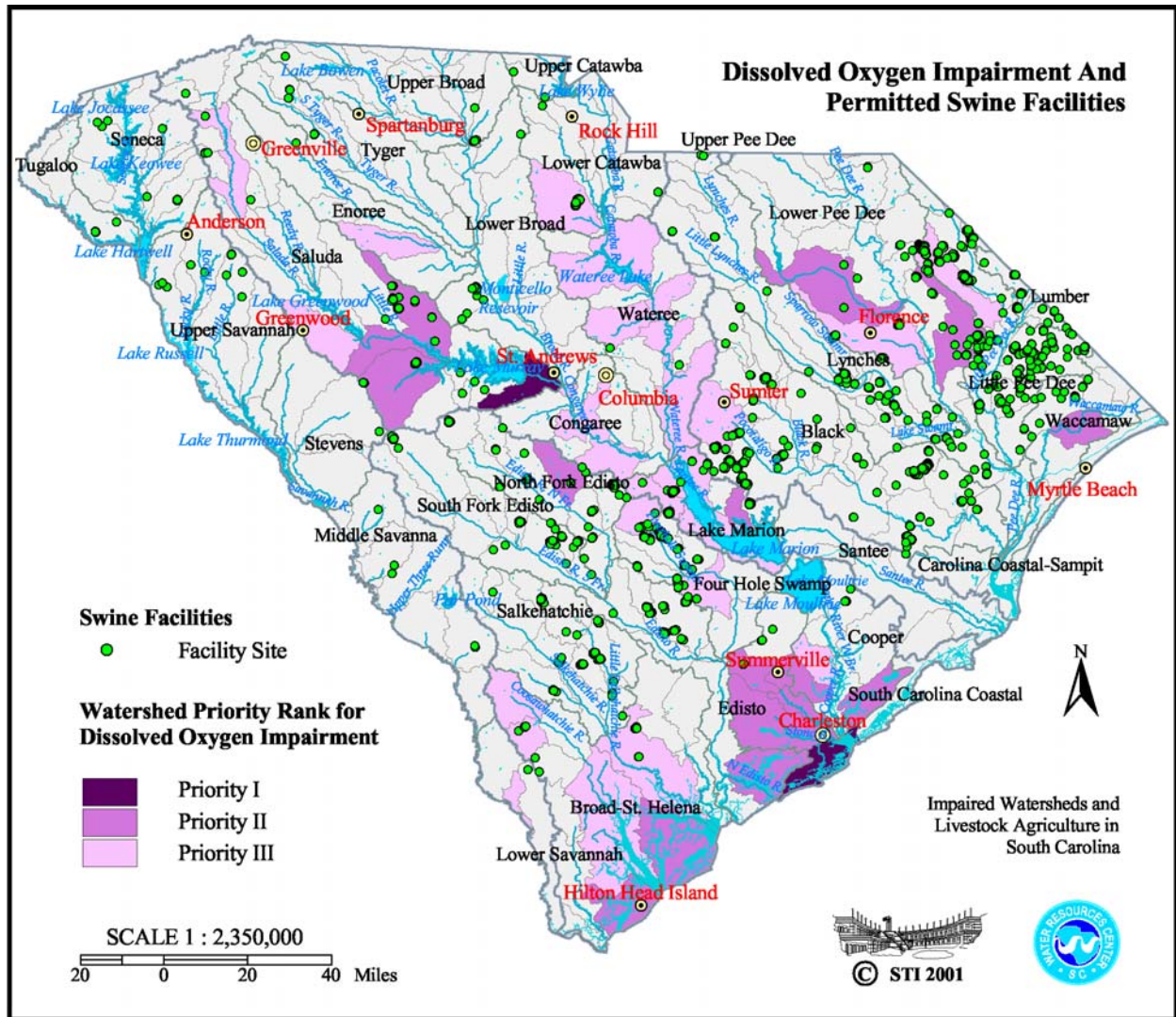
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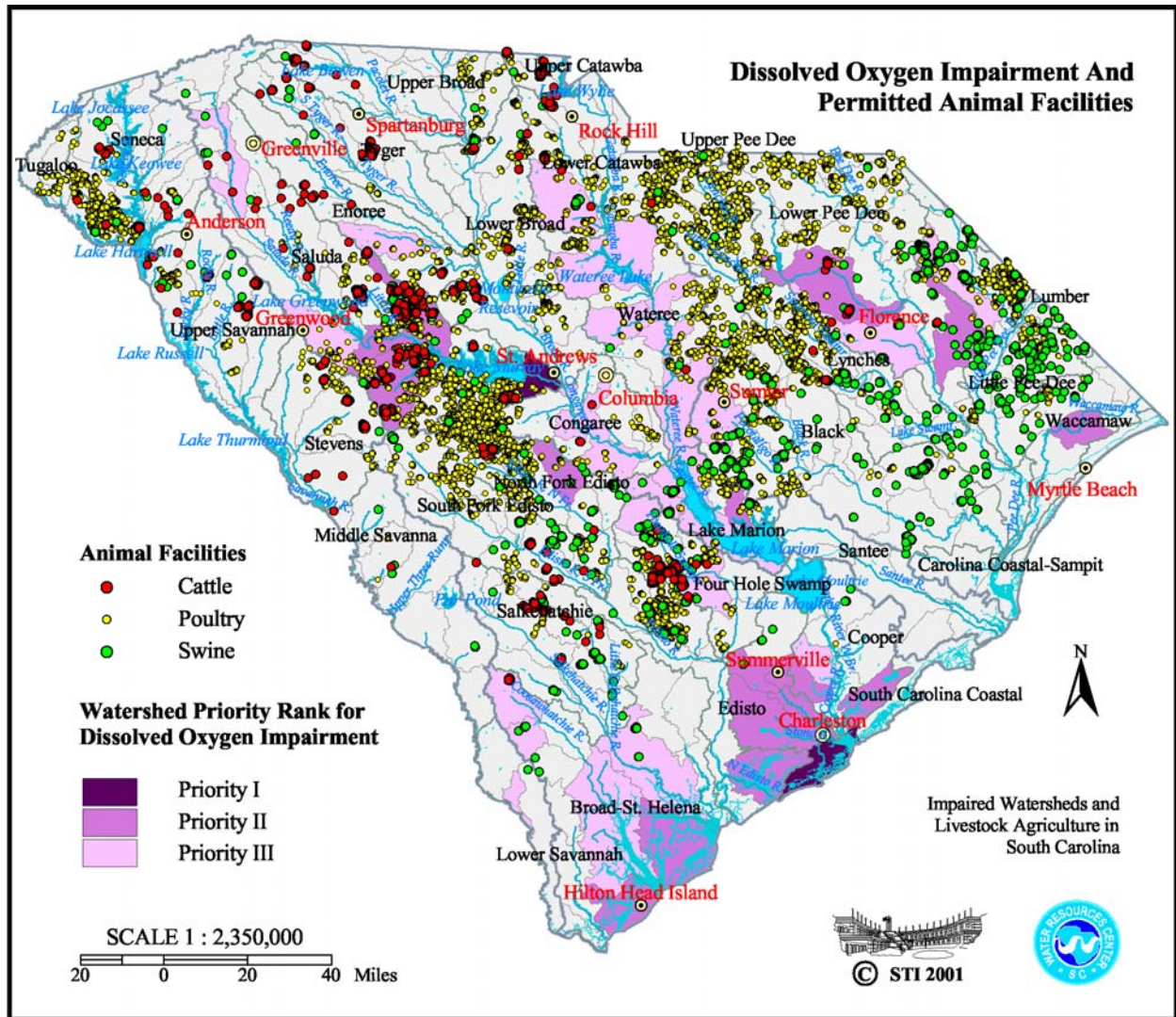
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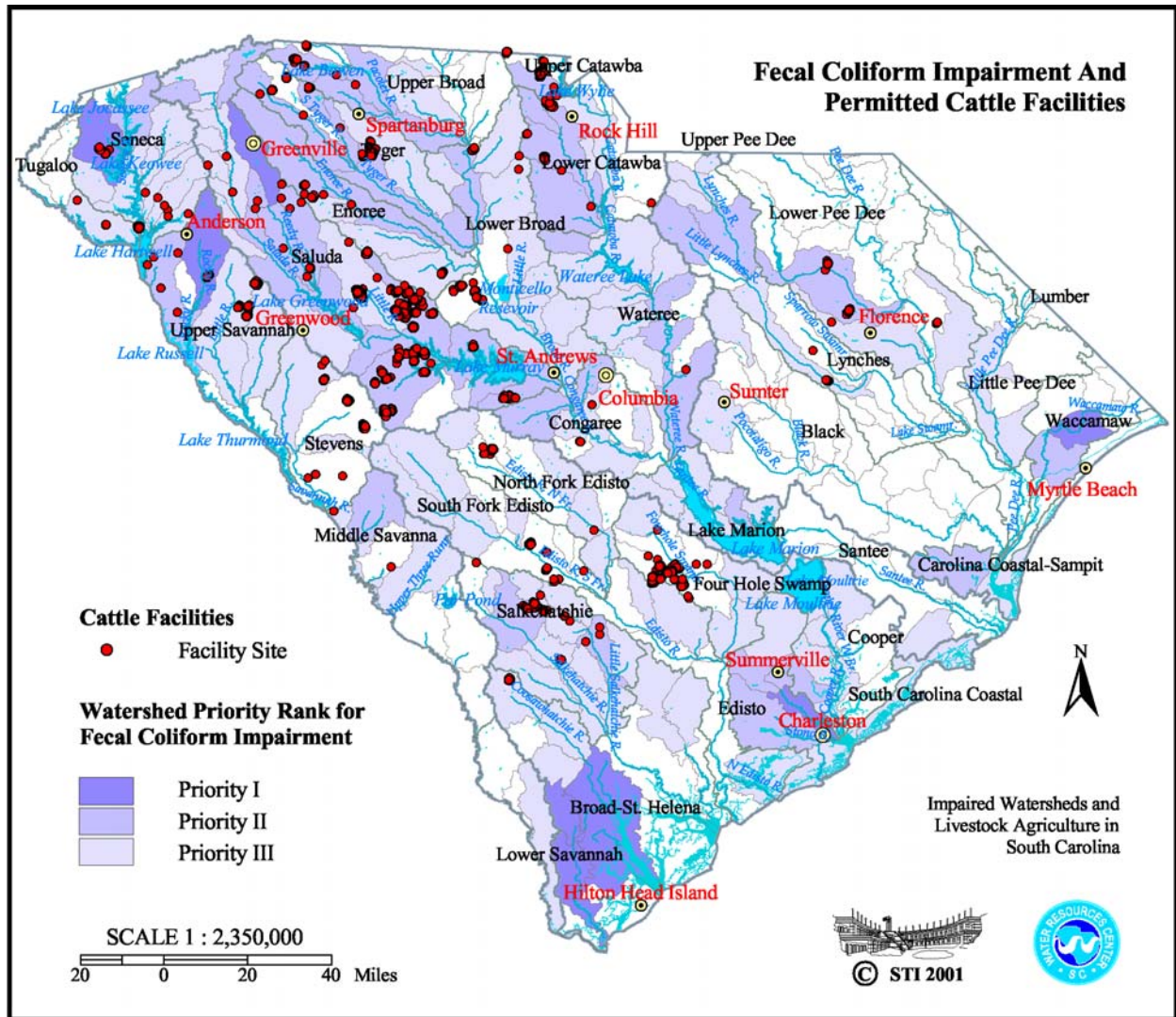
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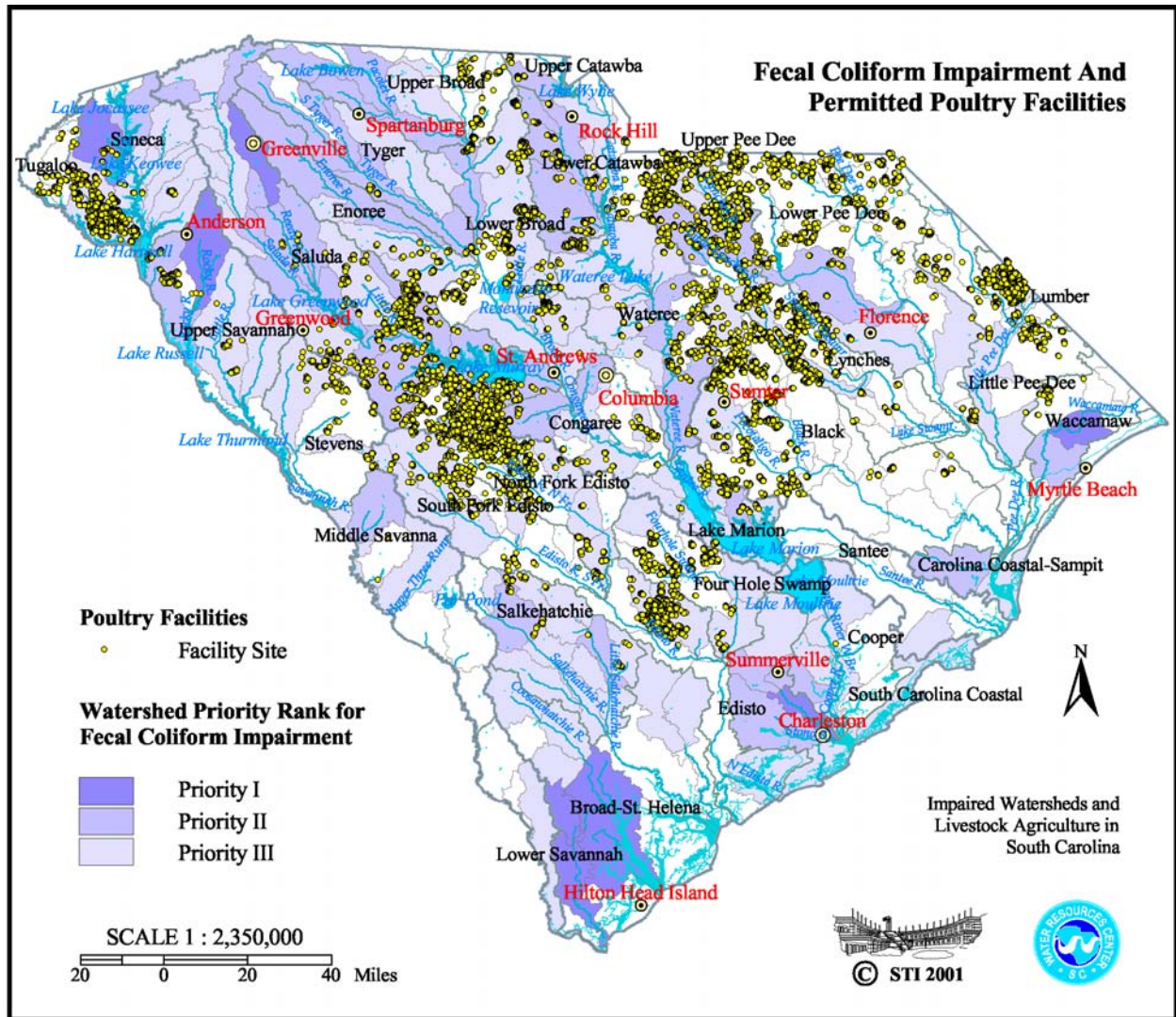
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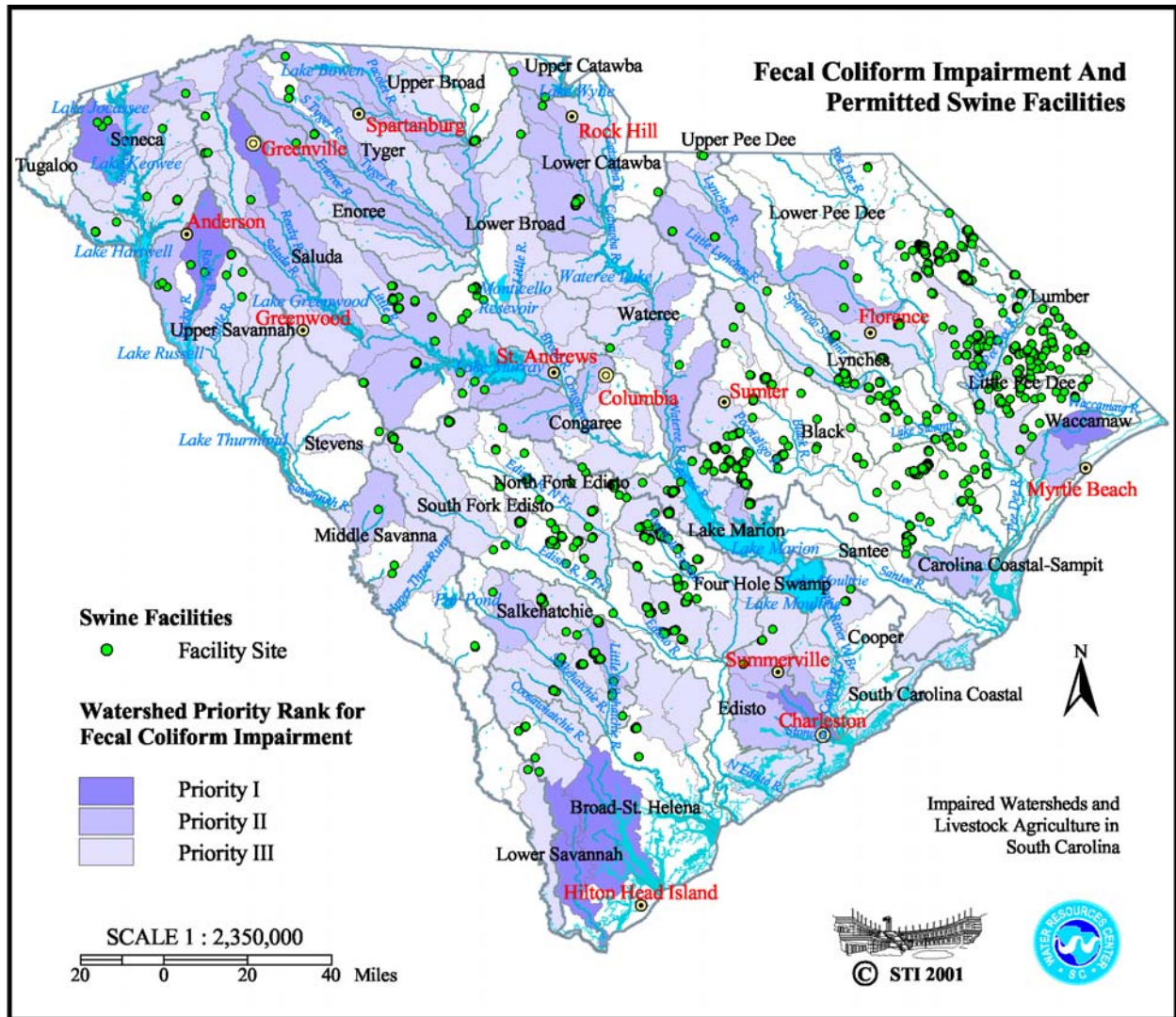
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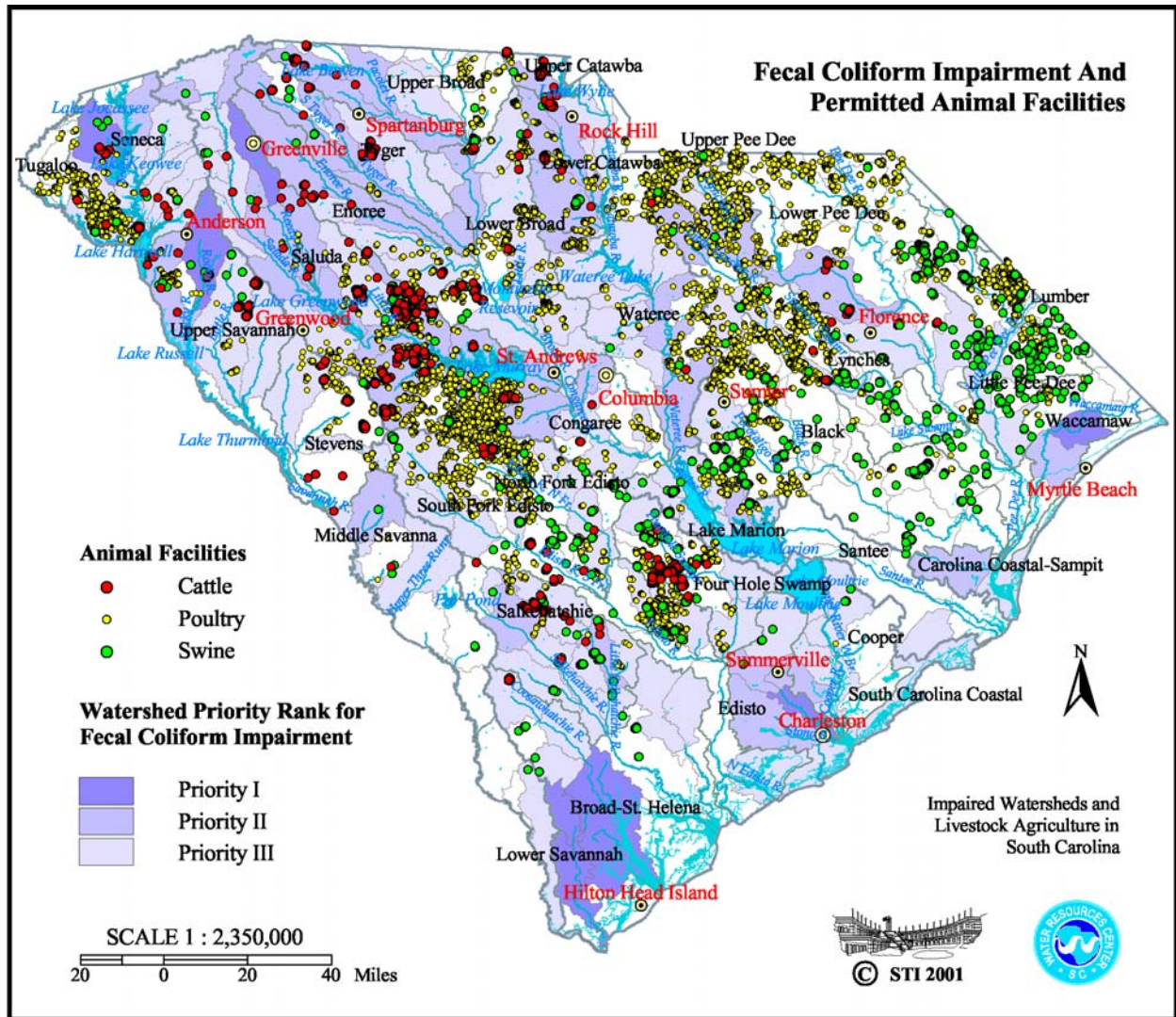
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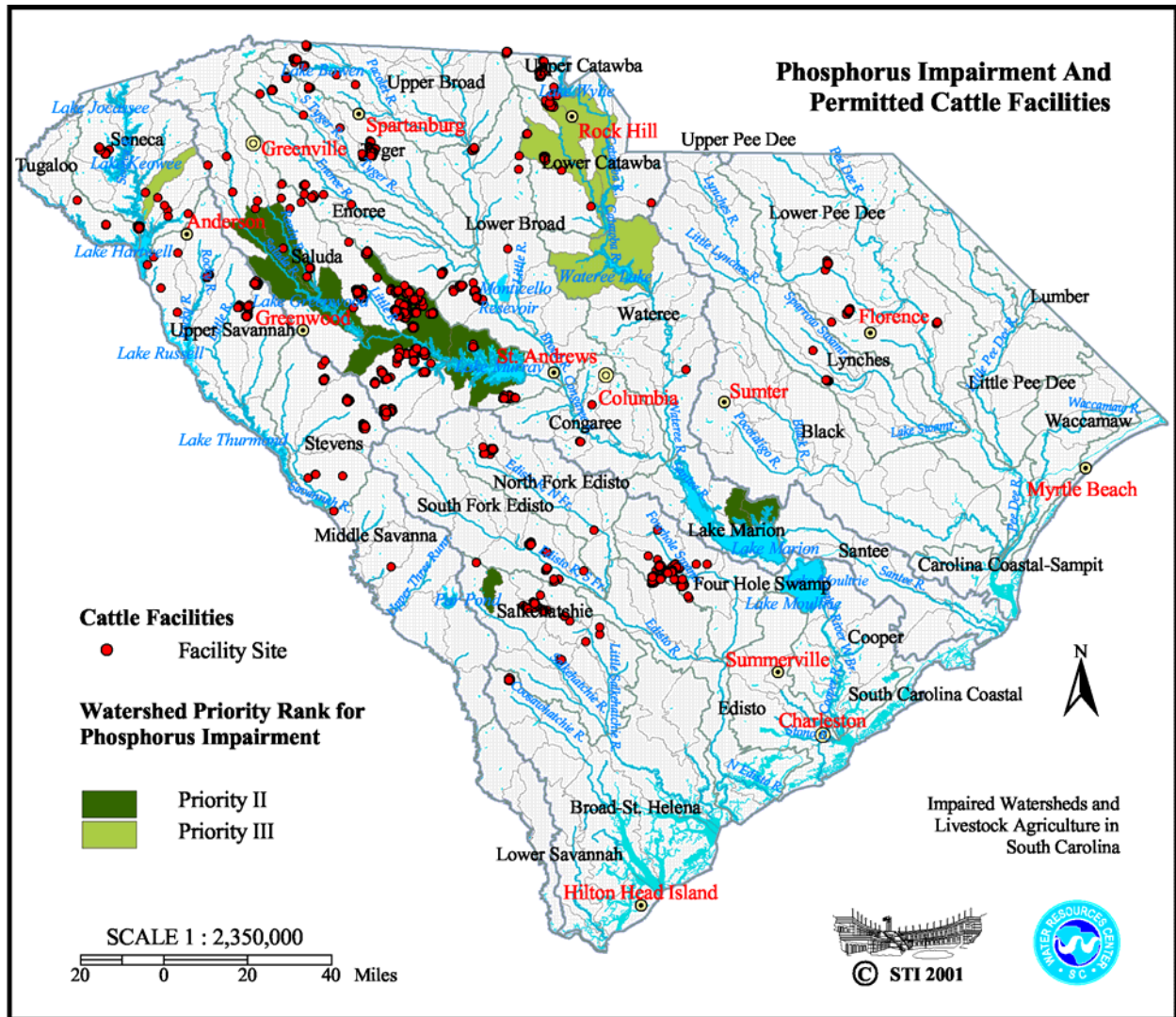
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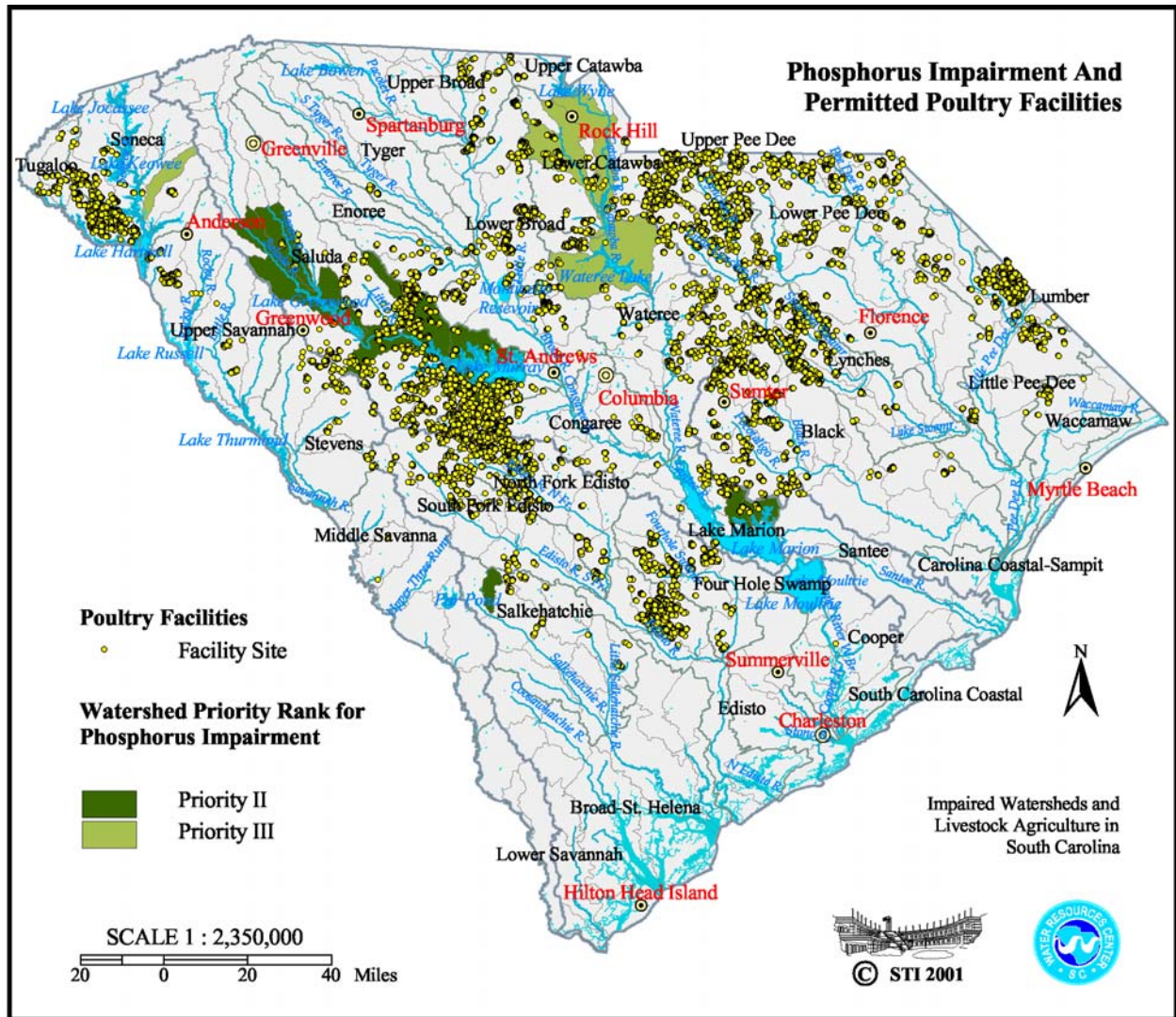
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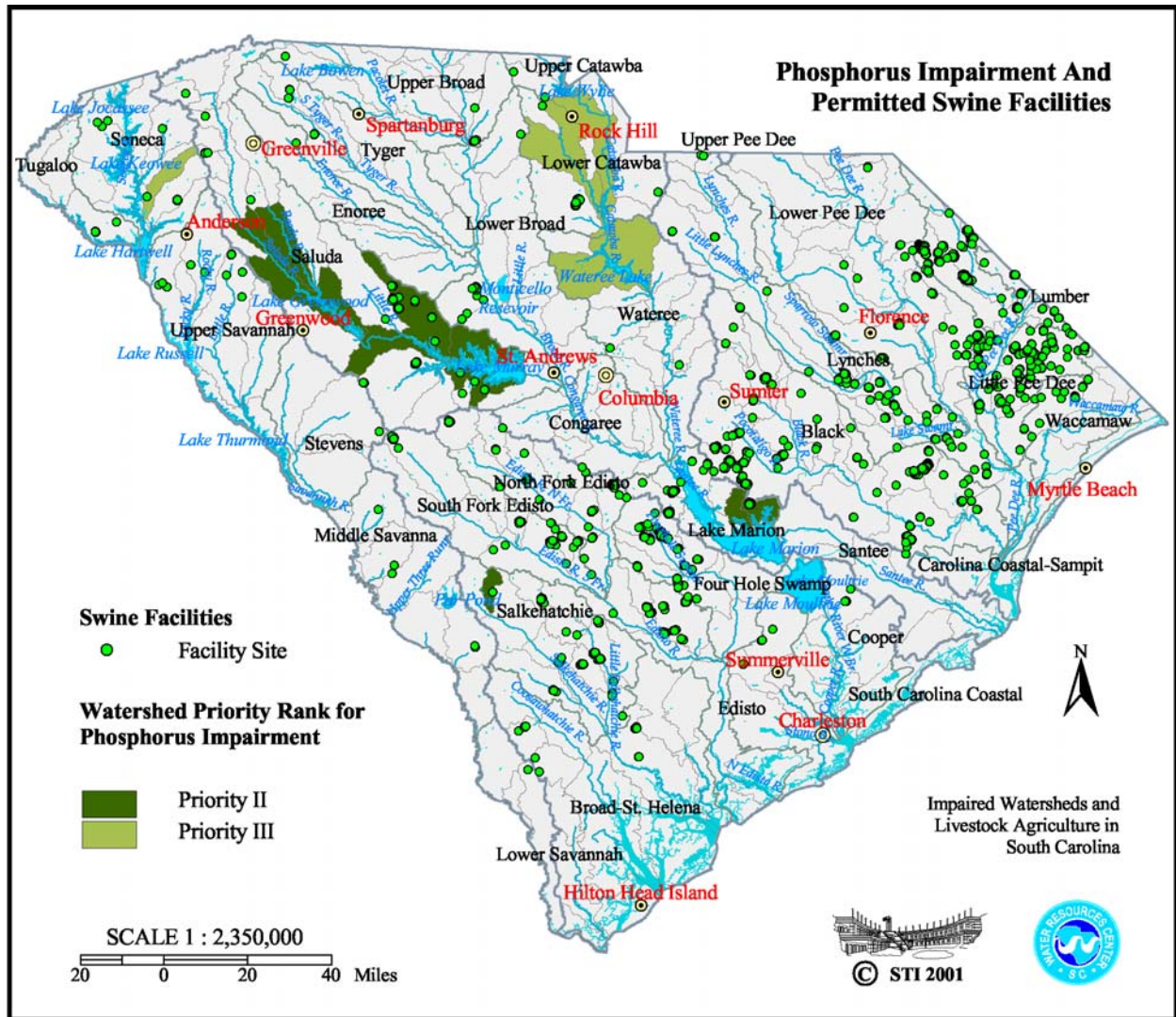
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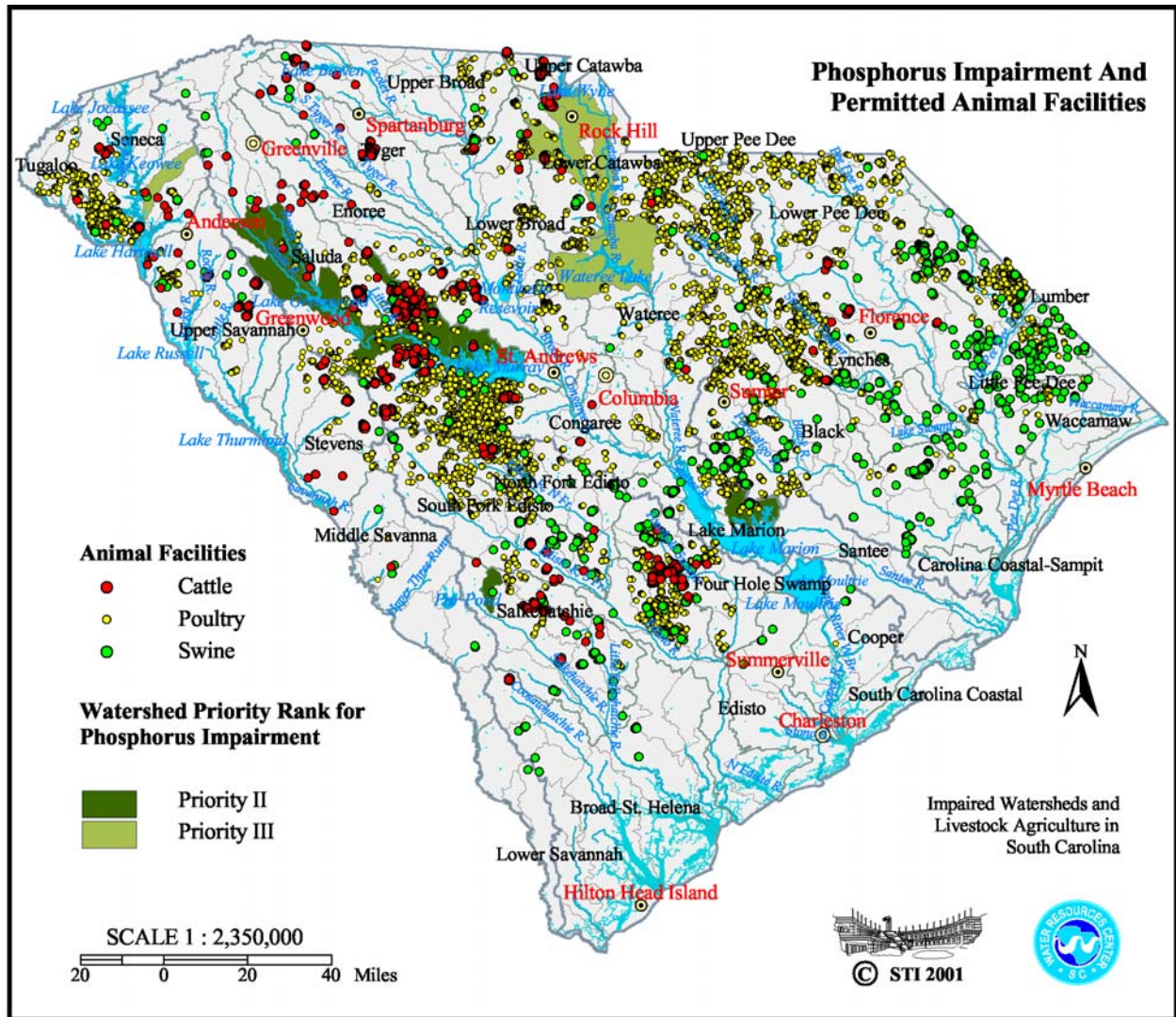
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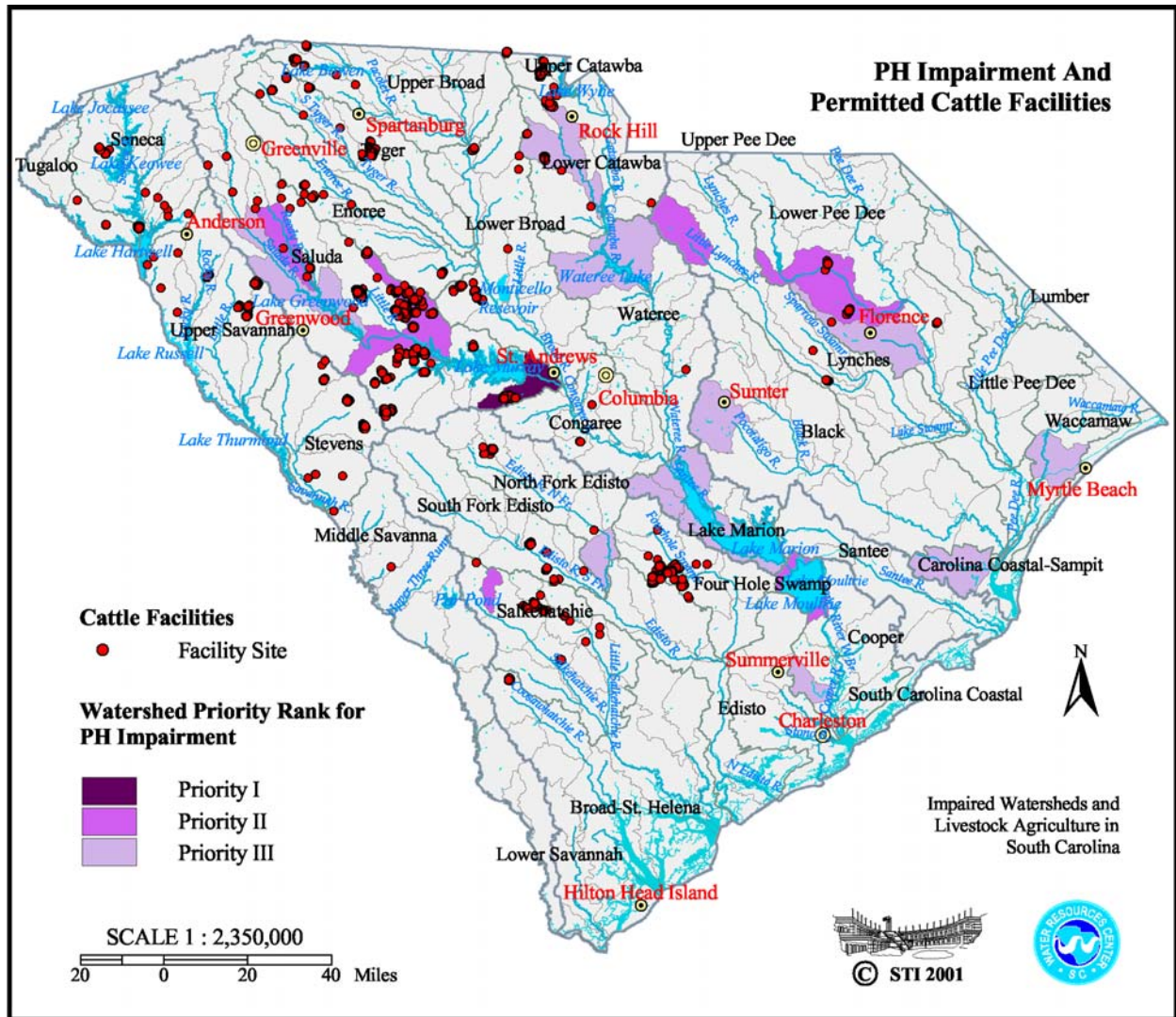
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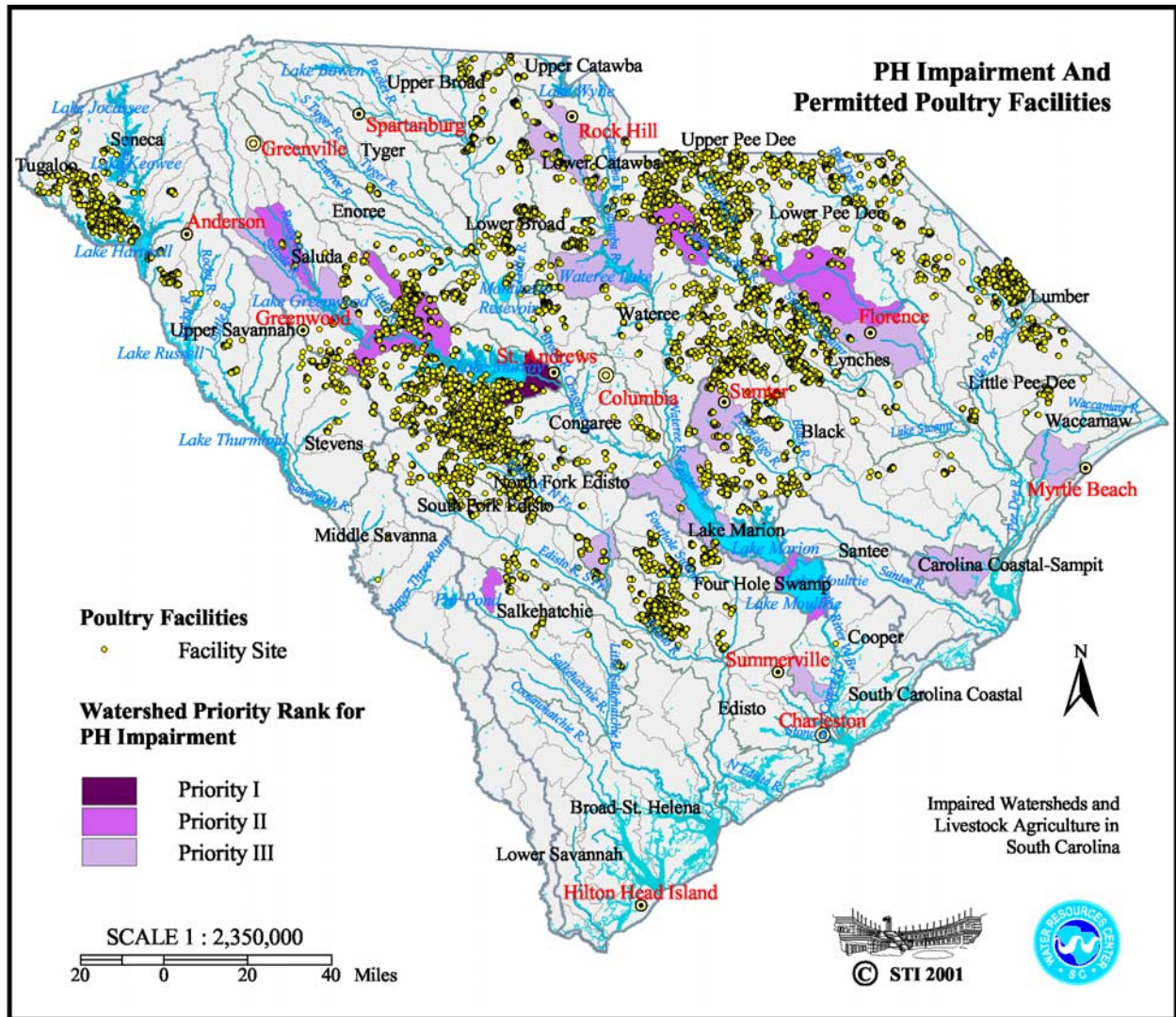
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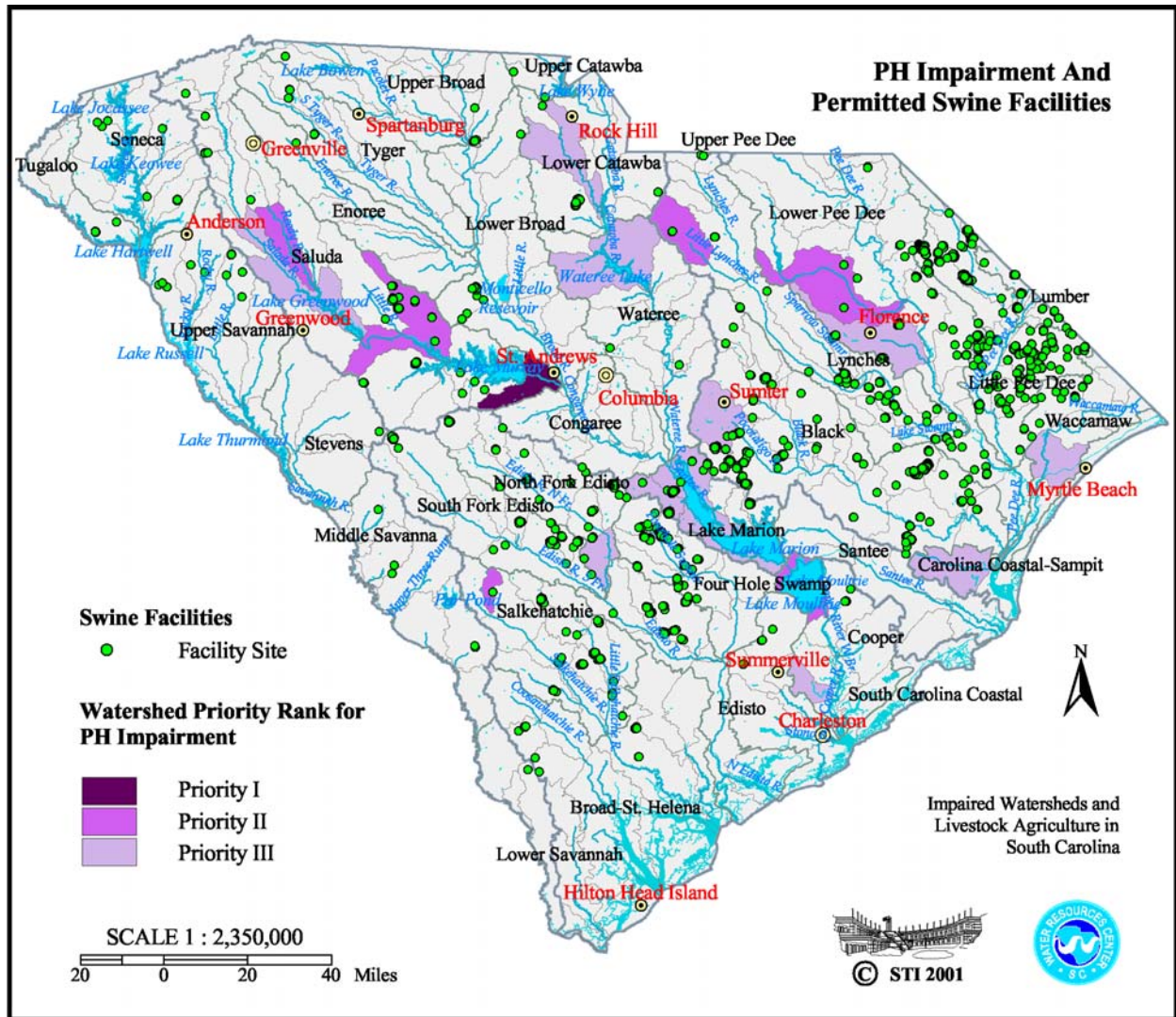
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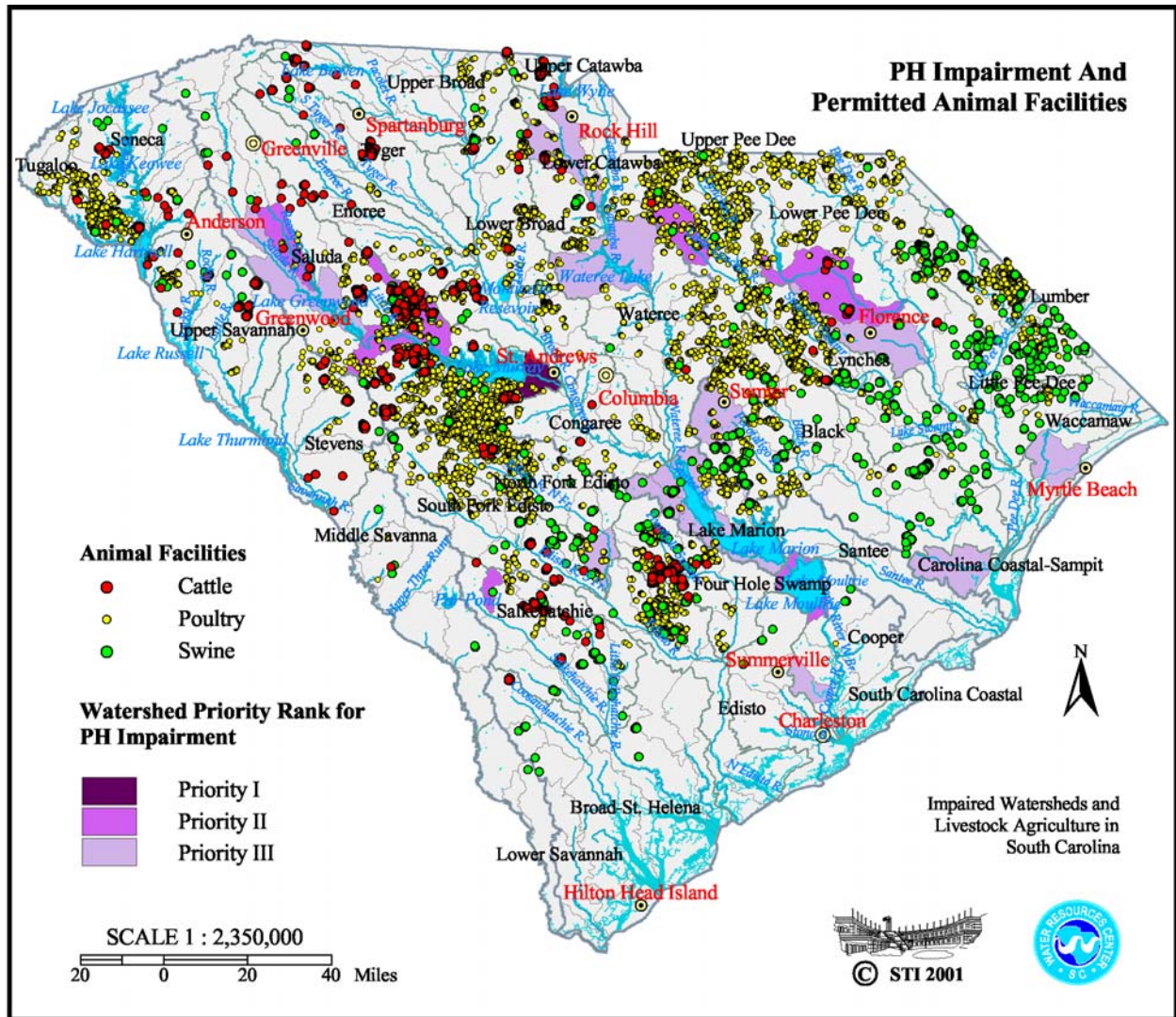
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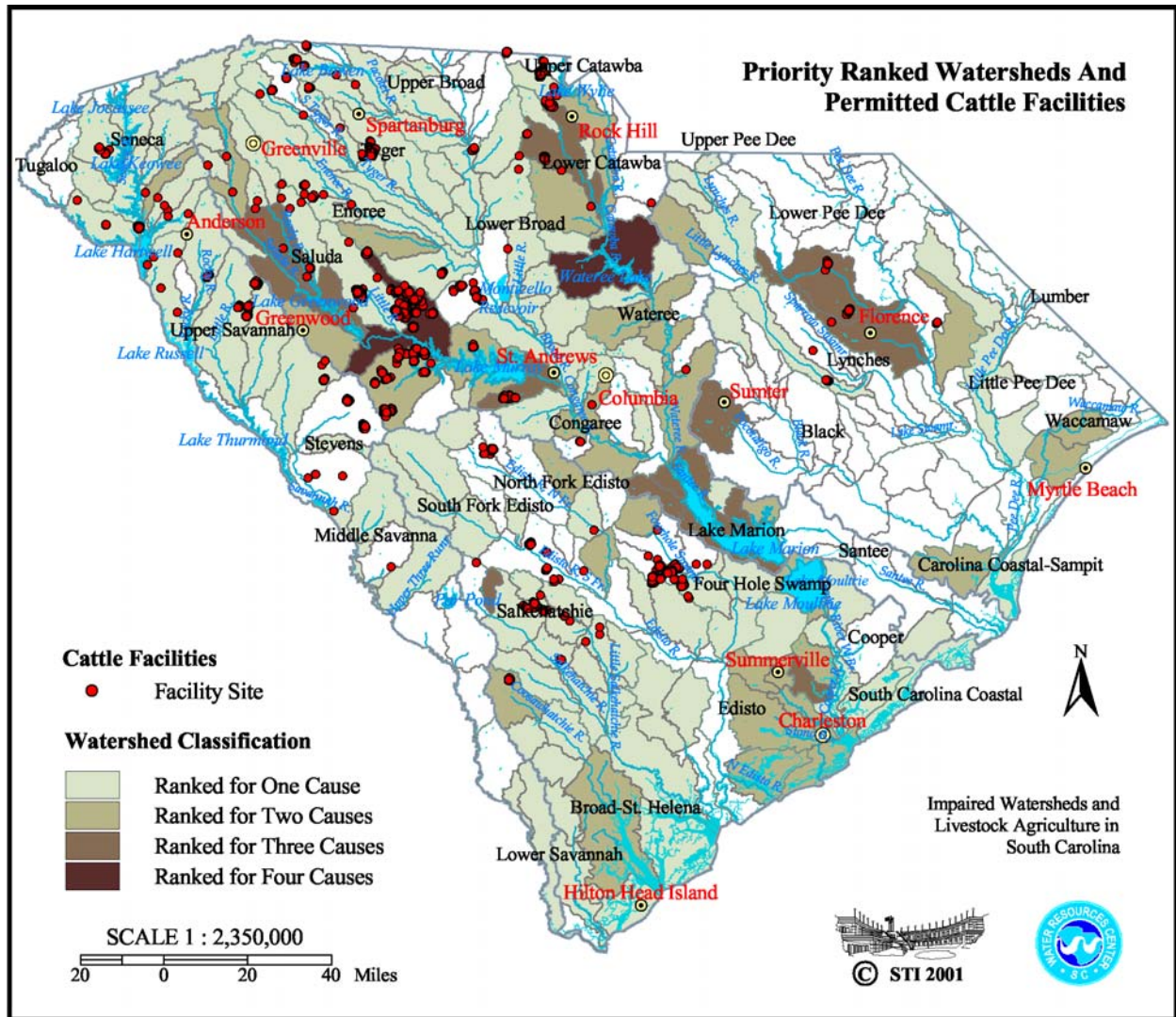
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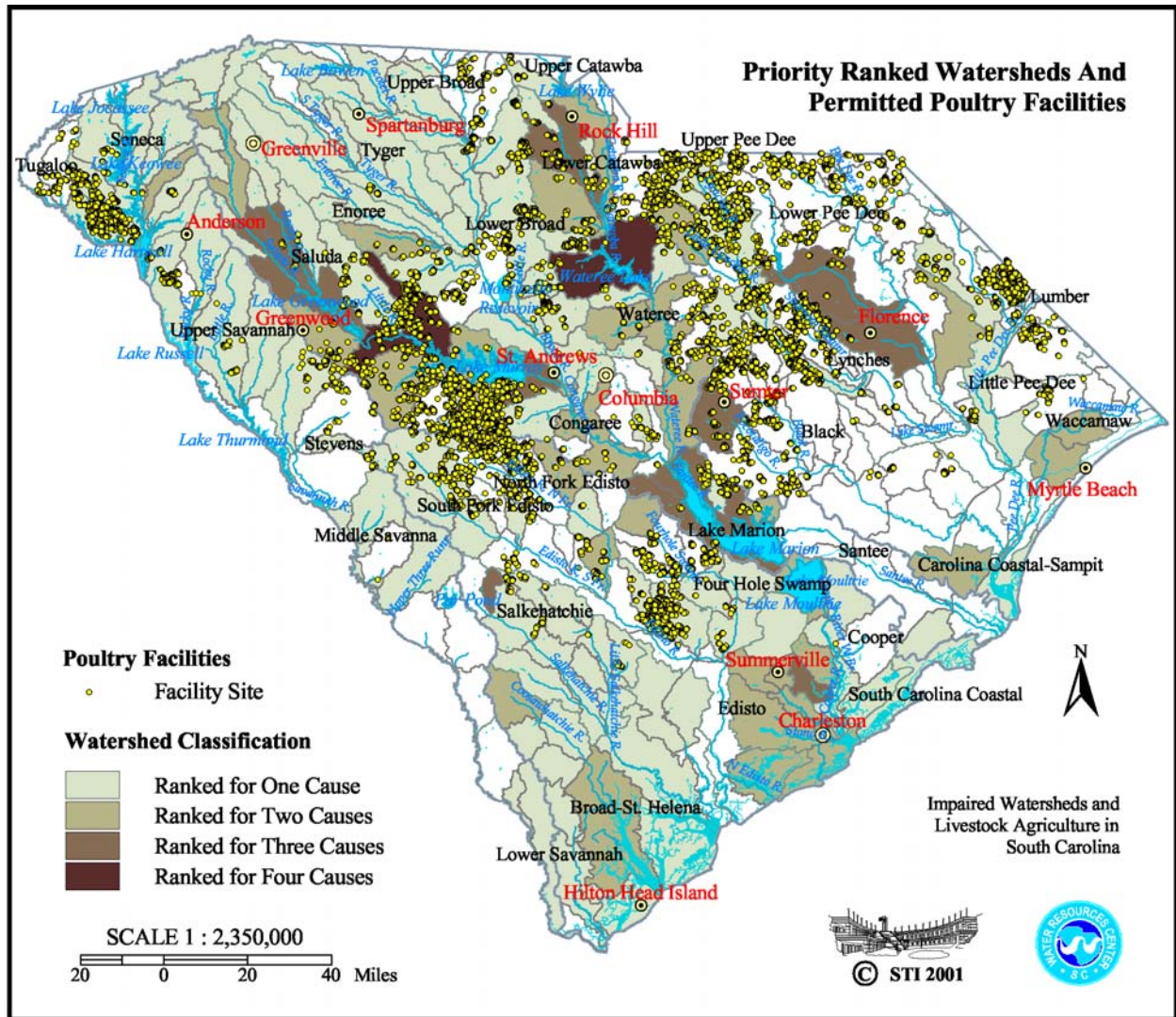
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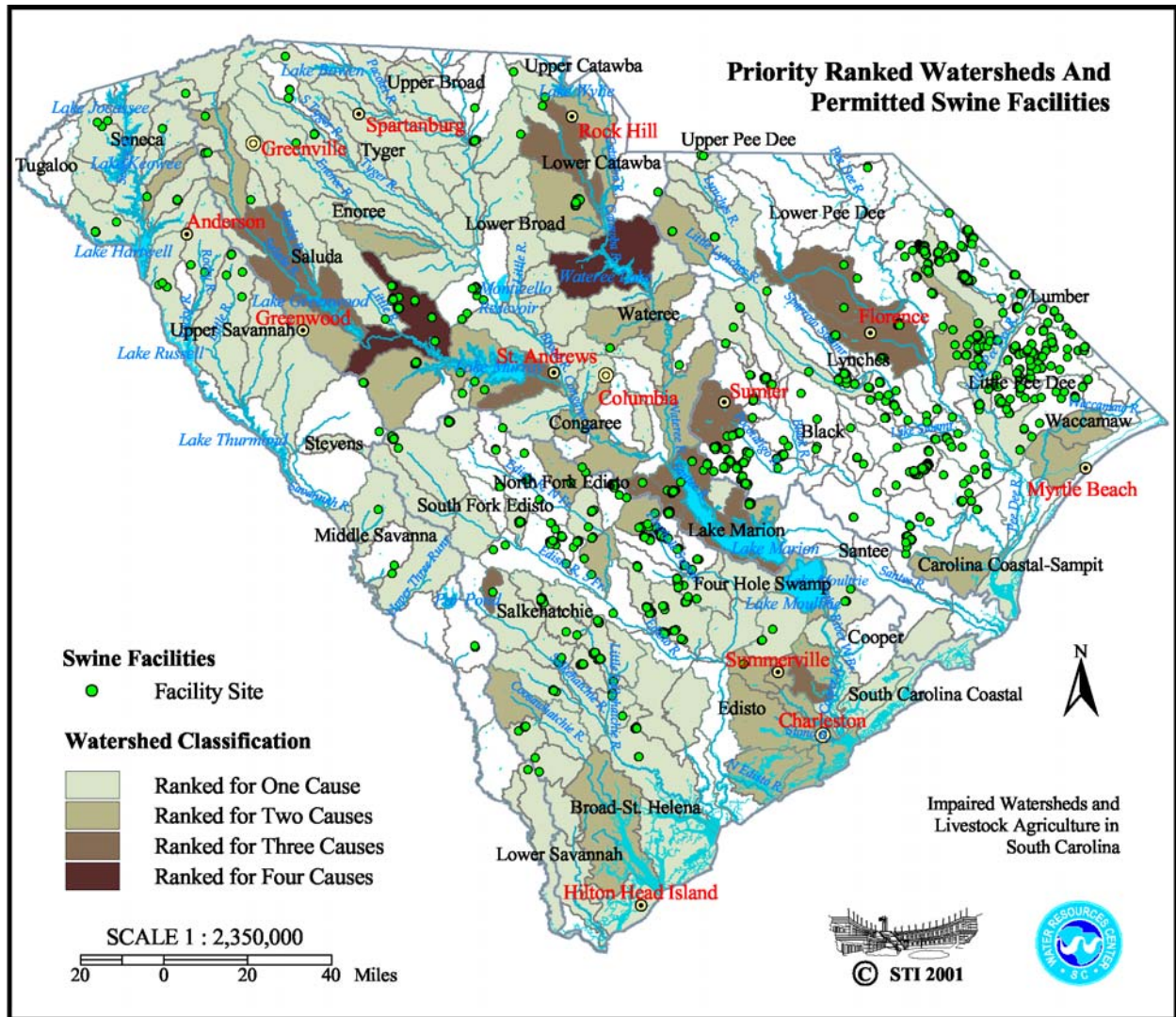
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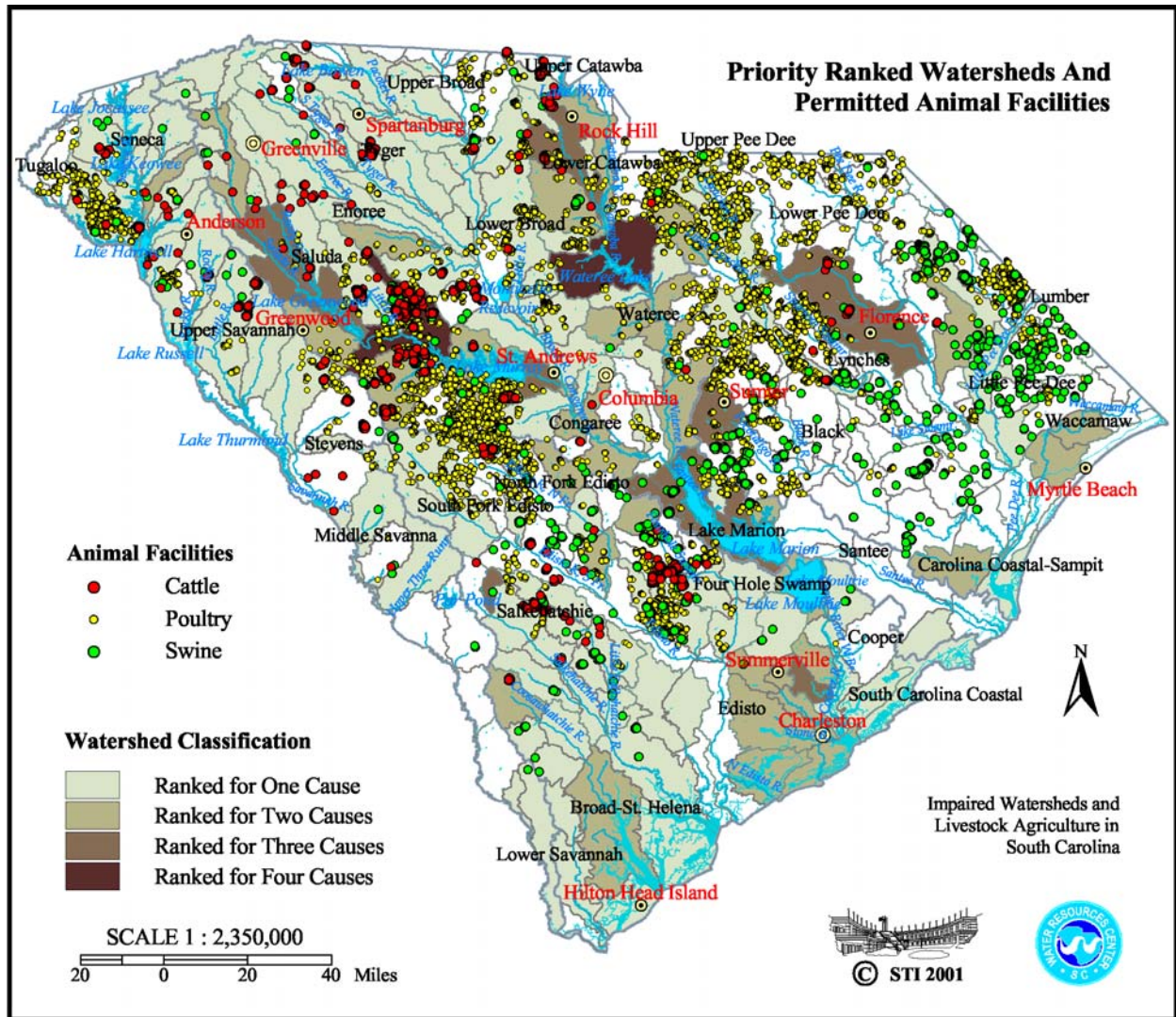
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The Changing Structure of Animal Agriculture

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.

I. The poultry industry.ⁱ

The poultry industry has become almost totally vertically integrated starting in the 1960s. 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, as whole roasted chickens at the deli counter, 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. However, flock sizes continue to increase. In 1997, nearly 48% of broilers and other meat chickens were raised on farms with 500,000 or more chickens., up from 35.5% in 1992. Farms with 750,000 or more chickens accounted for 26.4% of production.

Broiler and Other Meat-Type Chicken, U.S.

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+
1997	0.09	2.27	8.49	41.55	47.58
1992	0.18	3.21	12.73	48.35	35.53
1987	0.32	6.68	21.30	47.38	24.31
1982	0.47	10.39	28.77	44.63	15.74
1978	0.86	17.22	35.62	34.43	11.87

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 same level of success as the poultry companies in introducing new, high value-added products especially with respect to the fast food industry. Some progress is being made such as the Hardee's pork chop sandwiches and biscuits. Also, bacon is very widely available as an ingredient in many specialty sandwiches at fast food restaurants.

Hog operations have increased their sizes and their degrees of specialization. Although large "farrow-to-finish" operations 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. Vertical integration in the hog industry is likely to continue to grow.ⁱⁱ

Herd sizes continued to increase between 1997 and 1999. In 1997, 55.0% of hogs and pigs were raised in herds of 2000 head or more. By 1999, these large herds accounted for 68.5%. Extremely low hog prices in 1998 probably drove many small producers out of the hog business.

Writing for the National Pork Producer's Council, Dennis DiPietre of University of Missouri--Columbiaⁱⁱⁱ 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 (number of head), U.S.

Year	1-99	100-499	500-999	1000-1999	2000-4999	5000+
2001	1.0	5.0	7.5	12.0	22.0	52.5
1997	3.0	12.0	14.0	16.0	20.0	35.0
1992	5.5	25.5	22.0	19.0	28.00	
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.^{iv}

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.^v

Meat packing is a highly concentrated industry with the top four firms accounting for an estimated 80% of US 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.^{vi}

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. In some states packers are prohibited from owning the animals in a previous stage of production.

Beef Cows, Percent of Inventory by Size Group (number of head), U.S.

Year	1-49	50-99	100-499	500+
2001	28.9	19.1	37.1	14.9
1997	30.3	19.5	36.2	14.0
1992	32.6	19.6	47.8	
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 (number of head), U.S.

Year	1-49	50-99	100-499	500-999	1000+
2001	11.5	12.4	36.2	12.4	27.5
1997	12.5	13.5	38.1	11.4	24.5
1992	14	14.1	38.7	33.2	
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 total cows while the average number of cows 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% 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.^{vii}

Government programs have eliminated the risk of very low milk prices for producers. With price supports due to expire by 2000, prices will likely become more volatile. Cooperatives may feel the need to try to limit milk supplies in order to control prices better. This may lead to still larger and fewer cooperatives as they try to increase their bargaining power. Many observers feel that vertical integration will also increase as a result of more volatile prices.

Milk Cows, Percent of Inventory by Size Group (number of head), U.S.

Year	1-29	30-49	50-99	100-199	200+
2001	2.6	8.1	20.9	17.4	51.0
1997	3.5	11.5	26.0	20.0	39.0
1994	4.6	14.0	28.7	19.3	33.4
1991	6.3	16.6	31.7	45.4	

ⁱ Ward, Clement E. "Vertical Integration Comparison: Beef, Pork and Poultry." WF-552. Oklahoma Cooperative Extension Service

ⁱⁱ Ward, Clement E. "Vertical Integration Comparison: Beef, Pork and Poultry." WF-552. Oklahoma Cooperative Extension Service

ⁱⁱⁱ DiPietre, Dennis. "Reflections on the Role of Knowledge in the 21st Century Pork Industry.." <http://www.nppc.org/PROD/knowledge.html>.

^{iv} Ward, Clement E. "Vertical Integration Comparison: Beef, Pork and Poultry." WF-552. Oklahoma Cooperative Extension Service.

^v Ward, Clement E. "Structural Changes in Cattle Feeding and Meat Packing." WF-553. Oklahoma Cooperative Extension Service.

^{vi} Ward, Clement E. "Packer Concentration and Its Impacts." WF-554. Oklahoma Cooperative Extension Service.

^{vii} Manchester, Alden C. and Don P. Blayney. "The Structure of Dairy Markets: Past, Present and Future." USDA Agricultural Economic Report No. 757. September 1997.

The Economics of Regulation

Mellie L. Warner

Can Farmers Pass Along the Costs of Increased Pollution Control?

The statement "Farmers cannot pass along the costs of regulation (or environmental protection or higher feed costs, etc.) to the customer," can be found in many places and on many tongues. Is this a true statement? Sometimes or always? If so, when? The cases where the statement is true are narrowly defined. When applied to the broader market, the statement is false. Let us look at three illustrative cases.

First, suppose that farmers have made all their production decisions for the season. They have evaluated what prices are expected and what their yields (either crops or livestock) will be. Suddenly, something changes. Maybe the hog farmer expected to pay \$2.00 per bushel for corn and due to drought corn is \$3.50. The costs of growing out a hog are now higher than expected. He already has the pigs on hand so he can't just produce fewer hogs. He's made his commitment. The producer will make adjustments that are practicable such as feeding slightly less, seeking alternate feedstuffs, or selling animals lighter weights. But basically he is stuck, he's going to continue to feed the hogs to a marketable weight. Meanwhile, other farmers must do the same thing. With higher corn prices, the optimal weight for market hogs falls. Therefore, more hogs come to market sooner. If the new cost situation is expected to continue, farmers will also liquidate breeding stock, bringing even more pork to market. Short run demand for hogs is very inelastic (the quantity demanded does not change much when price changes), so the price of hogs falls. In the short run, an increase in production costs has led to a decrease in farm output prices. This is obviously no way to pass along costs. But this is a **short run phenomenon**. If farmers expected corn prices to remain high, they would plan on fewer hogs the next time around and prices would begin to rebound over time. (Of course higher corn prices would encourage corn growers to plant more corn.)

In the second case, suppose that one state, say Illinois, decides to tighten its environmental regulation of hog farms. Suppose the state passes regulations that are more stringent than those in other states. This would cause the costs of growing hogs to increase in Illinois, but would not affect the costs in other states. What happens to the price that Illinois farmers get for their hogs? Nothing much happens. The price for hogs is set in the national market by national level supply and demand. The impact of Illinois' regulations on the national supply curve is slight, so prices do not change much. Again, the farmers are not able to pass along the increase in costs because they apply only to the state market, not to the national market and we have free trade between the states. This is a **local market phenomenon**.

Third, suppose that national environmental standards are applied to all farms and that time is given for everything to adjust. Costs increase for everyone. The national supply curve shifts and prices increase. Because the national demand curve, say for pork, is very inelastic, prices increase almost as much as the increased costs of production. Farmers are able to pass along almost all of the increased costs of production through the adjustments

that take place in the free market. In fact, total income will increase due to the inelasticity of demand. One reason that supply will eventually shift is that some higher-cost farmers will find it uneconomical to adapt and they will be driven out of business. As prices rise to cover the "average" cost of reducing pollution, low-cost producers will tend to expand. This is the way a market economy works; the most efficient firms survive because they can produce at the lowest costs.

The important thing to remember is that most of the costs of regulations applied to the **entire market** will be passed along in the **long run** (when time is allowed for adjustment). This is why it is important to establish national standards rather than leaving them to the individual states. Otherwise, a state with slack environmental controls would give its farmers a cost advantage.

Even the long run scenario above fails to provide for something; it assumes that technology stays fixed as other factors adjust to the new regulatory climate. In reality, farmers will demand more efficient (cheaper) ways of reducing pollution. Firms looking to make money will try to find these cheaper ways. Some will succeed. The large numbers of farmers who desire these systems will help the firms achieve economies of scale in their own production. Competition will also help to lower prices of the systems.

Most economists believe that it is important to allow some flexibility for farmers to choose their own means of controlling their pollution. One method can be low cost for one farm in one kind of situation, but can be very costly in another situation. Allowing each farmer to choose what is the lowest cost method of meeting standards for his farm should ensure that pollution control is achieved at the least possible total cost.

Who Should Pay for Pollution Control?

Farmers think that they should not have to pay all the costs of new systems that will reduce pollution from farms. One reason is because of the widely held belief that costs cannot be passed along in higher prices. The section above contradicts this assumption.

Economic theory is neutral on the question of who should pay to eliminate an "externality," or a cost imposed on one group or individual by another group or individual's actions. According to the Coase Theorem, as long as property rights are assigned to one party or the other, the optimal level of production will take place. If the farmers have to pay the costs, they will reduce production to the optimal level. If the public has to bribe the farmers to reduce pollution, the same optimal level will be achieved. So the question of who pays becomes political and will be decided in the political process. In reality we have numerous federal cost-share programs, and both Federal and state technical assistance. It has recently been proposed that South Carolina offer environmental cost-share programs that add leverage to Federal ones.

Voluntary Versus Regulatory Programs

Economics tells us that voluntary programs cannot work. Suppose that two farmers have the same costs of producing hogs. If one farmer spends money to improve his pollution control, he has higher costs than his neighbor who doesn't. They both receive the same price when they market their hogs and the farmer who pollutes makes more money. This is the same as case two above where one state has regulations and the others do not. In a highly competitive market where profit margins are thin, there is great pressure to keep costs as low as possible. Only when the additional costs are imposed on all producers will compliance be achieved.

Update on Environmental Regulations Affecting Animal Agriculture in SC

A quick review of the history of animal regulations in South Carolina will show that our State has made significant changes in the way animal facilities are regulated in the last 25 years. The Clean Water Act of 1977 mandated that each State develop a program to protect the waters of the State. In response to this Act, South Carolina's Department of Health and Environmental Control (DHEC) developed environmental guidelines for animal facilities. These guidelines provided the first standards for the permitting of animal agriculture facilities in the United States. All new facilities were required to obtain a permit to operate before animals could be placed in the facility.

These guidelines served South Carolina well for a number of years. In the early 90's, however, the rapid expansion of the poultry and swine industries in the Southeast created an increased awareness of potential environmental concerns related to large animal-confinement facilities. As these concerns matured, many conflicts moved to the courts for resolution. In court, the legal status of the SC guidelines was often questioned, as they were not legislatively adopted regulations. To address this issue, the South Carolina legislature mandated the development of regulations to address the permitting and operation of animal agriculture facilities in the State. The first draft of these regulations for swine operations was adopted in 1996. In 1998, regulations for all other animal agriculture operations were adopted. It was stipulated that these first regulations be reviewed and revised after a fixed period. The process of review and revision for these facilities is now underway. It is anticipated that the revised regulations will be presented to the legislature in January 2002, and they would become effective July 2002.

So, what are some expected changes? Although the review process is only partially complete, there are some changes that appear to be fairly certain. Many of the changes are probably attributable to one of two situations. First, some of the original wording was vague and did not stand up in court. These sections of the regulations will be rewritten to clarify any ambiguity. Second, some of the well-intentioned ideas did not work well in the real world. These sections of the regulations will be changed to provide more realistic solutions to address the issues. Although the overall scope and content of the regulations will not change significantly, some specific components will be modified a great deal.

Some tentative changes include:

- 1) Currently, lagoons must have a natural and synthetic liner. Experience has shown that using both is not feasible. The new regulations will require one or the other, but not both.
- 2) Currently, soil samples in fields where manure is applied must be taken four feet below the surface. Experience has shown that sampling at this depth is difficult to achieve, may not provide accurate results,

and is probably not necessary. The new regulations will limit the depth of the soil samples.

- 3) Currently, the disposal of mortality in a pit is approved as long as the bottom of the pit is above the high water table level. To reduce the potential for ground water contamination, the new regulations will require that the bottom of the burial pit be two feet above the high water table level. Sites of concern can be further restricted from pit disposal.
- 4) A greater emphasis will be placed on the application of phosphorus to the land. The regulations will follow current NRCS recommendations which include that no phosphorous can be applied to land that has 500 pounds per acre of phosphorous. Additionally, a soil phosphorous index will be used to calculate phosphorous application rates. This index provides a site-specific recommendation based on site characteristics such as slope, presence of impaired waterways, rainfall, and erosion potential.
- 5) Although manure brokers are covered in current regulations since they apply manure to the land (similar to the farmer or land owner), the new regulations will include a section to specifically address the certification and regulation of manure brokers.
- 6) Education and certification of animal facility operators will be expanded to include all confined animal facility operators. Large swine operators will have to be certified, others will be required to take a waste management course, but there will not be any certification process.
- 7) There will be more emphasis on the role and responsibility of integrators in the management of waste produced on contract farms.

Concurrent to the modification of the regulations in South Carolina, the United States Department of Agriculture (USDA) and the Environmental Protection Agency (EPA) are in the process jointly of developing a "Unified National Strategy for Animal Feeding Operations (AFOs)". This federal action was initiated to address situations in some states where the states have minimal or no regulations for the operation of animal facilities. South Carolina will be less affected by the federal regulations than many states, due to South Carolina's existing regulations. Like the revisions on South Carolina's regulations, the federal program is still in the process of being developed. A brief summary of existing regulations and the new application of these regulations follows:

Under current federal regulations (Clean Water Act), facilities with over 1,000 animal units (approximately 1,000 beef cows) are called concentrated animal feeding operations (CAFOs) and are currently required to be permitted under the National Pollutant Discharge Elimination System (NPDES). These facilities are considered as "point source" systems and are regulated the same as any other industries that produces point source pollution. Of the approximately 10,000 CAFOs in the U.S. approximately 2,000 facilities have NPDES permits.

Animal facilities with over 300 animal units that discharge directly into waterways are also considered CAFOs and are required to have NPDES permits. Animal facilities less than 1,000 animal units are not considered CAFOs and are not required to have a NPDES permit. These smaller facilities (AFOs) are expected to voluntarily develop comprehensive nutrient management plans (CNMP) that address issues of feed management, manure handling and storage, land application of manure, land management, and record keeping. Additionally, AFOs of any size can be deemed CAFOs if they are “significant contributors to water quality impairment”.

So, without any change to federal regulations, EPA has the authority to require a NPDES permit for CAFOs which are defined as:

- 1) Animal facilities over 1000 animal units
- 2) Animal facilities over 300 animal units that discharge into a waterway
- 3) Animal facilities of any size that are considered to be significant contributors to water quality impairment.

EPA estimates that by simply enforcing existing federal regulations the number of NPDES permitted animal facilities will increase from the current 2,000 level to an estimated 15,000 – 20,000 units.

One additional change that could significantly affect the number of animal facilities that are required to have NPDES permits is a change in the definition of a CAFO. There has been some discussion of reducing the number of animal units to 500 (from the current 1,000) level. This change would mean that NPDES permits would be required for almost all of the existing commercial swine and poultry farms in the United States.

The Total Maximum Daily Load (TMDL) Rule

On July 13, 2000, the US EPA published its Final TMDL Rule¹ designed to fulfill the Goals of the Clean Water Act. A TMDL or Total Maximum Daily Load represents the maximum amount of pollutants that a body of water can absorb and still meet clean water standards. The goal of the rule is to clean up thousands more American rivers, lakes and coastal waters so that they will be safe for swimming and fishing and for fish and shellfish. Under the Final Rule, states will identify and prioritize all polluted waterbodies. The states will have ten years to develop these lists, but may be granted an additional five years if needed. EPA is requesting that waters used for drinking water or that support endangered species be given higher priorities.

A TMDL will identify polluted waterbodies, their particular pollutants and the desired water quality standard for each. Allowable amounts of pollutants will be specified along with the reduction in pollutant loads required to meet the water quality standards. Point sources of pollution will be given wasteload allocations. The effects of runoff and other pollution sources will be considered and an implementation plan developed. The plan will consider a safety margin, seasonal variation and foreseeable increases in pollutant loads. States will be allowed to phase in the new TMDL requirements during a transition period. The Final Rule allows flexibility to the states as to which waters are polluted and which are to be cleaned up first.

Unlike the proposed rule, "the Final Rule does not include specific permit requirements for forestry, and EPA withdraws its proposed provisions for expanded authority for permitting aquaculture and animal feeding operations."

¹ <http://www.epa.gov/owow/tmdl/finalrule/>

A Case Study of Permit Applications under the Old and New Regulations

The following case study relates the experiences of one farmer who 1) had a permit issued under the old regulations, 2) had a permit approved but ultimately denied under the old regulations and 3) had a permit ultimately upheld under the new regulations.

First Permit Under Old Regulations

The farmer applied for his first permit in 1994. A site inspection was performed in May of that year. In June 1994 permission was granted for the farmer to proceed with the planning and design of his facility. In order to obtain a permit to construct a no-discharge waste treatment system, the farmer would have to provide

- 1) a Waste Management Plan prepared either by a private, licensed engineer or the Soil Conservation Service (now NRCS) and a signed Application for Permit to Construct,
- 2) a statement that the owners will be responsible for operating and maintaining the waste system in accordance with design criteria, and
- 3) two required easements as discussed during the site inspection.

The two easements were signed on July 3, 1994. Note that these easements required the signers to indicate that they "have/have no objections to this construction." (Circle one.) This differs from the form required under the new regulations.

On July 26, 1994, the farmer submitted his Application for Permit to Construct. The proposed date for the beginning of operations was September 1, 1994. The Permit to Construct was issued on November 21, 1994. The operation consists of four broiler houses. The broilers are raised in houses with earthen floors topped with wood fractions. Waste is land applied. 20 special conditions were placed on the operation. The expected amount of waste is 900 tons based on 5 flocks per year (600,000 broilers per year.)

On December 15, 1994, a final construction inspection was performed. The permit to operate was issued on December 20, 1994. The first birds were placed in April 1995.

On February 22, 1996, a site inspection was conducted by DHEC for the purpose of determining the suitability of the site for a dead bird composter.

On February 11, 1997, a Permit to Construct was issued for the dead bird composter. This permit was appealed on July 3. On October 21, 1997, application for Permit to Operate the dead bird composter was approved. In May 1998, a judge ruled against the composter permit. On appeal permission to construct the dead bird composter was upheld and the composter was built.

Under the old regulations, the original permit for the chicken houses was approved in about seven months. Approval of the dead bird composter took approximately twenty months from the original site inspection until the Permit to Operate was approved.

Between May 1995 and February 1999, at least 23 inspections were made at the facility. Of these 9 were routine inspections, 13 were complaint-driven and 1 was a follow-up inspection. Only one unsatisfactory rating was given and it was for a routine inspection. Most of the complaints involved odors and flies, but DHEC did not find any permit violations on inspection.

Second Permit Under Old Regulations

On February 22, 1996, a preliminary site inspection was conducted for a proposed broiler operation to be run by the same farmer. On February 24, 1996, DHEC wrote giving permission to proceed with the planning and design of the system.

The letter indicated that the farmer again needed to submit

- 1) a Waste Management Plan prepared either by a private engineer or by the Soil Conservation Service (SCS),
- 2) a statement that the owners will be responsible for operating and maintaining the Waste system in accordance with design criteria, and
- 3) two easements that the farmer indicated were needed during the site inspection.

On May 30, 1996, DHEC received the Waste Management Plan for the facility which was prepared with assistance from the District Conservationist for SCS in Clarendon County. On July 23, 1996, DHEC issued a permit for the construction of four broiler houses. The farmer began construction of the broiler houses.

Eight months later in March 1997, the controversy over the chicken houses began. Parties involved included a member of the SC House of Representatives, the assistant to the Commissioner of DHEC, the owner of a tomato packing shed, the SC Department of Labor, and the SC Migrant Workers Department. Individuals who had signed waivers withdrew their consent. Others wrote to say that they should have been asked to sign waivers or just to protest

On April 16, 1997, another farmer filed a request with DHEC for administrative review of the permit to construct the broiler houses by the Administrative Law Judge Division. Additional petitioners moved to intervene in the matter on May 14, 1997. The two groups appealed the permit to build a dead bird composter on the existing facility on July 3, 1997. The motion to intervene was granted and the two appeals were consolidated on August 19, 1997. A hearing was held on November 24, 25 and 26, 1997 at the Administrative Law Judge Division Offices in Columbia.

On May 4, 1998, the Chief Judge issued his opinion in which he found that the permits for both the new facility and the composter had been improperly issued. He therefore denied the permits finding that

- 1) DHEC had failed to promulgate regulations as required by law. Because of this, the Petitioners and the public were unprotected and their rights to "a healthy

environment" and to "the unencumbered use and enjoyment of their property" were in jeopardy.

- 2) Under the Restructuring Act of 1993, jurisdiction over contested case hearings was transferred from DHEC to the Administrative Law Judge Division. Prior to this, DHEC both made the rules and interpreted them. The Administrative Law Judge should consider the department's guidelines to be evidence. However, the guidelines "do not have the full force and effect of law and do not establish a binding norm.
- 3) DHEC's guidelines specify that a facility must be located at least 1,000 feet from neighboring property lines unless a signed waiver is obtained from the owners of such property. The proposed barns would be only 200 feet from the property lines of Vonnie Ridgeway and Peggy Baxley and no waivers were obtained.
- 4) "...the generation of noxious odors, dust and contaminants will occur with certainty as a result of the normal biological process of the decay of poultry waste. Even optimal management practices will not eliminate these normal odors associated with poultry litter. The Department has taken the position in response to odor complaints about Mr. Wells' existing facility that such odors were normal incidents of a poultry facility and that no agency action was available so long as the facility was operating in compliance with its permit. The evidence clearly established--without serious dispute--that pungent, acrid, ammonia-like odors, dust and airborne contaminants will routinely be generated during the normal and proper operation of this poultry facility." The Department did not visit the site prior to writing the permit. The Department did not evaluate the transport of odors and other contaminants to neighboring residences nor did they evaluate the impact of the prevailing winds. "Furthermore, staff failed to evaluate the availability of alternative sites despite evidence that the farmer's extensive properties afforded other locations with superior protection for neighbors." No evidence was presented that DHEC considered imposing conditions on the permit to protect the neighbors. No evidence was presented to support the Department's departure from its own 1,000-foot setback guideline.
- 5) The Department's argument that it is limited to considering the issues of environmental and health protection and pollution control "... fails to recognize that these odors and dust emissions are themselves a threat to the health and welfare of the Petitioners as well as to Petitioners' use and enjoyment of their property." Legislation effective July 1, 1996, requires the Department to avoid permitting a source of nuisance odors and to require remediation of such emissions. The Department recognizes its responsibilities in this area in its permitting guidelines and cannot now "pass the buck" to local zoning and land use authorities.
- 6) The Department failed to protect the property rights of the Petitioners and their right to due process.

In light of these findings, the Judge denied the permits for the new broiler houses and the dead bird composter.

On June 4, 1998, DHEC and the farmer appealed the Judge's ruling to State of South Carolina Board of Health and Environmental Control.

On October 8, 1998, the SC Board of Health and Environmental Control upheld the denial of the permit for the chicken broiler houses. The decision was based solely on the fact that the facility was less than 1,000 feet from adjoining property lines as required in the Department's *Agricultural Facility Permitting Requirements of the Bureau of Water Pollution Control*.

In this case permit approval took about three months from the time of the initial site inspection. Then another eight months passed during which time construction was begun. Only then was the permit appealed. The final decision to revoke the permit was issued on October 8, 1998, more than two and a half years after process was begun.

Permit Under New Regulations

On September 22, 1998, SCDHEC conducted a preliminary site inspection for a proposal to build four (4) broilers houses on the property. On October 2, 1998, DHEC wrote to the farmer stating that the site appeared to be suitable for the broiler operation and giving permission to go ahead with the formulation of the necessary waste management plan. The letter also outlined some of the required procedures and regulations.

DHEC determined that two neighbors had to be notified of the farmer's intention to construct new broiler houses. The farmer hand delivered the Public Notice of Intent to Construct to one neighbor on October 5, 1998, who refused to sign. The farmer mailed a Public Notice of Intent to Construct to the other neighbor. She signed at first, but then scratched out her name and wrote in "Refused to sign" and returned the form dated October 10, 1998, to the farmer. The form clearly states that no rights are forfeited by signing the form.

On November 5, 1998, the farmer filed a Waste Management Plan with SCDHEC for the construction of 4 broiler houses to be built in the Bloomville community of Clarendon Country. Each house would have the capacity to hold 22,000 birds at a time and 5 flocks could be produced each year in each house. The plan indicates that the set back distances for the broiler facility itself would greatly exceed those required by South Carolina's regulations. Setbacks for the land application areas would meet those required by the regulations. The amount of land available for land application of waste is 284 acres. The amount of land needed to apply all the waste (537 tons) at agronomic rates for the proposed corn, wheat and soybean crop rotation is 215 acres.

A Permit to Construct was issued by the Bureau of Water of SCDHEC on December 24, 1998 with an effective date of January 12, 1999. The permit included 25 Special Conditions that must be met by the operation. A public notice was placed in The Manning Times on December 24, 1998 notifying the public that a permit had been issued to construct the new broiler facility.

On January 8, 1999, the clerk of the Board of SCDHEC received an appeal of the permit. Six individuals were listed as Petitioners. SC Department of Health and Environmental Control and the farmer were listed as Respondents. The basis for the appeal was that the

community was already suffering from smells from an existing broiler facility owned by the farmer. The Petitioners also expressed concern over water quality. Approximately 80 signatures were attached to the letter of appeal. The construction permit was suspended pending the appeal

On June 7, 1999, the appeal was heard by a Judge in the ALJ Division. The Petitioners were represented by an attorney. SCDHEC was represented by an in-house attorney. The farmer represented himself. The farmer is the owner of an existing poultry operation and is in partnership with his father and sister in the farm that proposes to build the new facility being appealed here.

The Petitioners' witnesses all testified that they had been troubled by odors from the farmer's existing chicken houses ever since they were first built. They feel that they are severely limited in their ability to enjoy activities. They are concerned about health issues (for example, asthma attacks), water quality and property values.

The Respondents' witnesses testified that all rules for issuing a permit had been followed. Setback distances are being observed and setbacks for the new facility will exceed the minimums required. The farmer has installed a composter to take care of dead animals. He has received a permit to build a stacking shed. These plus his use of chemical litter treatments should be sufficient to control odors.

On August 4, 1999, the Judge filed his judgement in the case. The Judge found that the petitioners had failed to meet the standard of a preponderance of evidence on the two issues that formed the basis of their appeal:

1. "Whether the permit was properly issued pursuant to the applicable statutory and regulatory laws.
2. "Whether Respondent's construction and utilization of the broiler houses would negatively affect the surrounding community by creating nuisances from flies, dust, and odor detrimental to the health of the residents."

The Judge found that the permit did conform to laws and regulations, it contains restrictions that should prevent nuisances and that, in the case of nuisances, the Petitioners have recourse through DHEC or the courts.

On January 13, 2000, the farmer was informed by letter that the Judge's ruling had not been appealed by the Petitioners. Thus, the judge's decision became the final decision on the case and the farmer was free to begin construction of the broiler facility.

Under the new regulations, the permit was approved in three months. The appeal was filed 15 days later on January 8, 1999. A hearing was held five months later. The appeal was denied after an additional two months. After five more months, the farmer was allowed to begin construction. Sixteen months had elapsed since the first site inspection.

Animal Agriculture in the News

Animal agriculture stories often make the morning news. Following are some examples from recent years. Searching the Internet will likely turn up more stories.

The Effects of Hurricane Floyd

Hurricane Floyd was arguably the most significant environmental event of 1999. Up to 24 inches of rain fell on eastern North Carolina. Twenty-six hog farms were flooded. Vast amounts of pollution were released into the environment including manure, mud, sewage, chemicals, petroleum and animal carcasses.¹ This caused great concern among environmentalists who feared damage to the estuaries of the state.

In December 1999, Governor Jim Hunt and other state officials were still concerned about losses to the fishing industry. But others closer to the industry felt that things were not so bad; losses had been higher in earlier, smaller hurricanes. Clamming was suspended as it is following any large storm. Some species were washed downstream where they were caught by a different group of fishermen. Overall, fall fishing was average or better.² However, the Marine Fisheries Division reported in July 2000, that the overall catch for 1999 was down from 180.2 million pounds worth \$101 million in 1998 to 153.4 million pounds of fish and shellfish worth \$98.9 million in 1999.³

In March 2000, top water researchers at their annual meeting were still uncertain what the impact of Floyd would ultimately be. The early days after the hurricane had seen vast plumes of pollution extending into North Carolina's rivers. Fresh water extended farther than usual down the rivers. An extra dose of nitrogen and phosphorus equal to six months to a year's normal input was washed into the rivers. However, the vast amount of rainwater diluted the contaminants. Thus, in March it was unclear whether the net effect on aquatic life would be negative from oxygen depletion or have a positive impact on the food chain. One NCSU researcher noted that pfiesteria is unusual after a large storm.⁴

Hurricane Floyd highlighted some problem areas in the state. Some enterprises should be prohibited in flood plains and flood maps need to be examined and updated.⁵ The aftermath Floyd has provided a window of opportunity to buy out some of these firms. In November 1999, the Raleigh News & Observer reported that North Carolina's Clean Water Management Trust Fund had granted

¹ Raleigh News and Observer, September 26, 1999, p A26.

² Raleigh News and Observer, January 16, 2000, p A1.

³ Raleigh News and Observer, July 12, 2000, p A3.

⁴ Raleigh News and Observer, March 31, 2000, p A3.

⁵ Raleigh News and Observer, October 31, 1999, p A1.

the Department of Environment and Natural Resources \$5.7 million for a voluntary buyout program aimed at removing hog waste lagoons from flood-prone areas. However this sum would only purchase about 15 farms and 180 hog farms are currently located in flood plains.⁶ In August 2000, the buyout began with environmental easements being purchase from 14 farms for an average of \$288,000. These farms represent 32 lagoons and 25,000 hogs. Another 30 farms were identified from applications as good candidates for buyout, but another \$30 million are needed.⁷

A fish kill on the Neuse River in June 2000 could well have been caused by lingering pollution from Hurricane Floyd. Much of the pollution was flushed out by rainwater, but enough remains in the sediment at the bottom of the river to cause problems. Although the river is prone to low oxygen areas, this year's extends much further.⁸

A early July fish kill in the Pamlico River was likely caused by pfisteria. Ninety percent of the dead fish had sores though testing was needed to confirm the cause.No mention of Hurricane Floyd was made.⁹ Shrimp trawlers dragging their nets through the waters of Moore Creek and Bay River killed 110,000 fish as the shrimping season opened. Oxygen levels should remain normal since crabs will likely scavenge the dead fish before they can decompose.¹⁰ A fish kill in Marsh Creek in Raleigh was caused by a homeowner's draining his swimming pool into the creek. The number of fish killed was not known. Weekend rains flushed the killer chlorine from the creek. Marsh Creek drains into Crabtree Creek which drains into the Neuse River.¹¹ On a July tour of a section of the Pamlico River, Governor Jim Hunt found that the fisheries had returned to normal. Tests to determine if problems might lurk in the river sediments will be performed.¹²

⁶ Raleigh News and Observer, November 20, 1999, p A22.

⁷ Raleigh News and Observer, August 12, 2000, p A3.

⁸ Raleigh News and Observer, June 17, 2000, p A3.

⁹ Raleigh News and Observer, July 3, 2000, p A3.

¹⁰ Raleigh News and Observer, July 21, 2000, p A3.

¹¹ Raleigh News and Observer, July 21, 2000, p N11.

¹² Raleigh News and Observer, July 22, 2000, p A3.

North Carolina's Agreement on Lagoons

On July 25, 2000, North Carolina Attorney General Mike Easley announced that an agreement had been reached with Smithfield Foods to phase out hog waste lagoons on farms owned by Smithfield. Smithfield controls 70% of the hogs produced in North Carolina. In addition to the 276 company owned farms, the company contracts with 1204 other operators. Although the agreement officially covers only the company owned farms, Smithfield asserts that it will provide assistance to its contract growers in the form of information on new technologies as well as financial assistance.¹³

Under the agreement, Smithfield will pay \$15 million to North Carolina State University for research on new technologies to replace lagoons as the waste disposal system of choice. Smithfield will spend an additional \$50 million on environmental projects over 25 years. NC State reports having five technologies ready for testing and another dozen under development.¹⁴ Smithfield has agreed to implement the new technology within three years when one has been approved. NC State has been given the authority to make binding decisions on acceptable technologies.¹⁵

¹³ Raleigh News and Observer, July 27, 2000, page A1.

¹⁴ Raleigh News and Observer, July 26, 2000, page A1.

¹⁵ Raleigh News and Observer, July 29, 2000, page A3.

Innovative Solutions

Many cities, states, universities, corporations and other groups are seeking solutions to the problems associated with animal agriculture, in particular, manure. These are often tailored to specific situations, but they can provide ideas that may lead to even better solutions. The following are just a sampling. No endorsement of any specific system is to be inferred.

In Texas, transportation officials and environmental officials are working together to solve two problems. Manure that is a threat to water supplies will be composted and then mixed with organic matter such as grass clippings and tree trimmings. The mixture will be applied to roadsides where it has been difficult to grow grass such as the Aransas Pass. This will reduce erosion, beautify roadsides and remove the threat of manure contamination of streams.¹⁶ A system of grants will encourage participation by farmers and state agencies.¹⁷

In Colorado, a pilot project is hauling yard waste, restaurant and food processor waste and brewery waste to a farm in Longmont where it will be mixed with manure to be composted. If the pilot project is successful, a network of farms for composting will be established. Using farms is cheaper than setting up an independent composting site for the Boulder community. Again, two problems have a combined solution.¹⁸

In New Mexico, Corrales Elementary School constructed a wetlands to treat school waste when its septic tank system began to fail. The school could not afford to build or operate a conventional treatment system, but needed to protect local wells and the nearby Rio Grande. The school's waste has extremely high levels of ammonia. Traditional wetlands break down ammonia, but cannot break down the resulting nitrates. Therefore, a treatment system was developed using both anaerobic and aerobic bacteria in different layers of the pond. A subsurface aeration system adds oxygen to promote plant activity during the winter months. The system is so innovative that it has been granted a patent.¹⁹ Constructed wetlands have been used to treat animal waste.

In Wisconsin, the state is proposing to generate electricity from methane produced from manure. Manure will be collected from farms and taken to a larger farm where it will be pumped into a tank. Microbes will attack the manure producing methane, carbon dioxide and potentially useful solids. They estimate the microbes could produce 300,000 cubic feet of methane a day. Nearby generators would burn the methane to produce electricity which would then be sold to electric utilities.²⁰

¹⁶ Anna M. Tinsley, Corpus Christi Caller Times, August 21, 2000.

¹⁷ Richard L. Smith, Waco Tribune Herald, August 26, 2000.

¹⁸ Elizabeth Mattern, Boulder Daily Camera, July 27, 2000.

¹⁹ NewsReal's IndustryWatch, July 31, 1999.

²⁰ Associated Press, August 25, 2000

The Land Grant Universities are actively involved in research looking for solutions to the manure problem. Here are a few of the ideas being looked into.

Clemson University is looking at the problem from several angles. The Agriculture and Biological Engineering Department has projects looking at the application of swine and poultry waste to commercially grown trees. In the Manning project, they have found no groundwater contamination despite the fact that the monitoring wells are located within the stands of trees where the waste is applied. Various application schedules are being followed. Only the spring fertilization plots received sufficient rainfall for the trees to use the nutrients, but these trees showed up to a 40% increase in wood volume produced over the course of the experiment so far. Previous work with the application of municipal sludge to trees has shown that tree diameters increase. This means that the timber shifts into higher value classes. A second project at the Sandhills REC has not been underway long enough to show growth results, but the groundwater has remained clean. This project will also investigate the results of a one-time, heavy application of turkey litter to trees. This could lead the way to long term arrangements between poultry farmers and tree growers where an entire stand of trees could be fertilized over a long period of time. At Clemson's Starkey Swine Center, loblolly pines and sycamores are being fertilized with liquid manure. Although the sycamore is one of the less valuable pulpwoods, the fact that the stumps will regenerate, avoiding the large initial costs of establishing a stand, may make it an economical crop. Harvests every five to six years might be possible with fertilization.

Clemson University is also looking into separation technologies to segregate the solid matter in waste from the liquids. Some of these systems use settling or mechanical separators. Another involves the addition of a biodegradable polymer to manure; this can remove 80% of the volatile solids. Although researchers at Clemson have found the generation of electricity from manure to be uneconomical, they find potential for the use of methane directly for water or space heating in winter and manure drying in summer. Dried manure can be transported more cheaply because it has less volume and weight.

Researchers at Penn State University are getting the jump on another potential waste disposal problem associated with hogs: lard and other fats. Health conscious Americans are consuming less lard, but hogs continue to produce lard and other fats as by products. Penn State "found that lard and choice white grease can replace No. 4 or No. 6 fuel oil in a process steam boiler with little or no retrofitting." Because there is virtually no sulfur or sulfur compounds in pig fat, no sulfur dioxide is produced. Only about one-third of the nitrogen oxides are produced and almost no ash. While these fats currently sell for more than fuel oil, that could change as the market changes.²¹

²¹ Pennsylvania State University News, August 21, 2000.

Purdue University researchers have determined that the amount of nutrients excreted in manure can be reduced and thus odor reduced by managing the feeding of hogs. When feed is ground finer, digestibility increases and nutrient loss decreases. Feeding of excessive proteins should be avoided although some situations require higher levels of protein than others. Supplementing diets with amino acids can reduce nitrogen excretion and with phytase enzyme can reduce phosphorus.²²

Oklahoma State University has planned a new state of the art swine research center. They plan to remove 90% of offensive odors using microbe remediation and biofilters made from hay.²³ The University of Minnesota has done research on manure aspects of manure use and disposal.²⁴ The University of Arkansas received a grant of \$600,000 from the state of Arkansas in July 2000 to study the causes of odor at swine farms, specifically what part of the hog's digestive system causes the noxious odors.²⁵ Among other universities with extensive research on manure problems are North Carolina State University,²⁶ Iowa State University,²⁷ and Texas A&M University.²⁸

Several for-profit companies are marketing systems or products to reduce the problems associated with manure. Ammonia Hold, Inc.²⁹ manufactures products to reduce odor on the farm and in other settings. The products work by reducing ammonia levels rather than by masking the odors. Anoka Aquaculture of Minnesota has developed a device to run an electric current through the slurry stream as it flows from barns to the lagoon. The alternating current reduces odor by converting the noxious compounds in the slurry to less offensive ones. A bonus effect is that the current kills fly pupae and larvae in the slurry.³⁰

NVIRO International Corporation³¹ has a system that adds mineral byproducts such as the kiln dust from the cement and lime industries to manure and other biosolids. A chemical reaction produces heat which kills pathogens and eggs. A marketable soil amendment is the final product. This is another process than uses two waste streams to produce a valuable product. Bion Environmental Technologies, Inc.³² uses biological and engineering processes to convert organic waste streams such as manure into a soil amendment.

²² Nutritional Strategies for Reducing Manure DM, N, and P Concentrations, Brian Richert and Alan Sutton Purdue University.

²³ Progressive Farmer Today, May 2000.

²⁴ <http://www.bae.umn.edu/extens/manure/compost/index.html>

²⁵ Dallas Morning News, July 30, 2000.

²⁶ http://www.cals.ncsu.edu/waste_mgt/

²⁷ <http://extension.agron.iastate.edu/immag/PolicyResearchFr.html>

²⁸ <http://tammi.tamu.edu/>

²⁹ www.ammoniahold.com

³⁰ Deborah Hyk, Hogs Today Magazine, November/December 1998.

³¹ www.nviro.com

³² www.biontech.com

Environmental Products and Technologies Corporation³³ has a closed-loop system for treating all aspects of the waste stream.

³³ www.eptcorp.com

Controversies

There continue to be instances of controversy over animal agriculture around the country. Many of these occur where traditional animal agriculture exists in an area that is being developed for other purposes such as housing developments. Sometimes they pit farmer against farmer. Here is a sampling of recent events.

In Olivia, Minnesota, a beet farmer returned from vacation to find his beets (and the soil they were growing in) missing. While he was gone, a neighboring farm was transferring manure when a hose burst, spilling manure into the beet fields. The farmer estimates that 100,000 gallons were spilled although those responsible put the spill at 10,000 gallons. Some of the beet plants left behind were killed by the manure.³⁴

In California, the Center on Race, Poverty and the Environment has slowed expansion of the dairy industry in traditional dairy areas such as Tulare County and Kings County. They claim that the potential for pollution has been inadequately studied. Dairymen are concerned that new dairies will chose to locate in other states.³⁵

Controversy arose over plans by a family farm to build a 500 cow dairy confinement barn in the karst area of southeastern Minnesota. The karst area is particularly susceptible to sinkholes because of limestone caverns under the surface. Environmentalist fear that sinkholes could open up under the storage bins or in a field that had been spread with manure.³⁶ The Minnesota Pollution Control Agency Citizens Board decided that the environmental concerns were not serious enough to stop the project.³⁷

The Delmarva Peninsula (parts of Delaware, Maryland, and Virginia) is home to an unusual concentration of chicken farms. Only recently have the states made a serious effort to police the farms. In August 2000, Maryland announced plans for more stringent regulations. The proposed rules would make the poultry companies rather than the contract growers responsible for the proper disposal of chicken litter. The poultry companies are opposed to taking the responsibility of policing their growers and will contest the proposal.³⁸ Although the Delaware Nutrient Management Commission has expressed their opposition to similar rules in that state³⁹, the US EPA is proposing similar regulations for Delaware.⁴⁰ Large poultry companies in the area such as Purdue, Townsends, and Allen Family Farms have long histories of improper disposal of poultry

³⁴ West Central Tribune, August 8, 2000.

³⁵ Scripps-McClatchy Western Service, August 6, 2000.

³⁶ St. Paul Pioneer Press, May 22, 2000.

³⁷ St. Paul Pioneer Press, May 24, 2000.

³⁸ Washington Post, August 9, 2000, p. B01.

³⁹ www.delawareonline.com, August 10, 2000.

⁴⁰ www.delarwareonline.com, September 7, 2000.

wastes.⁴¹ In one case, Tysons built the manure storage sheds required by a settlement, but didn't bother to actually use them.⁴²

In Missouri, over a dozen farmers contend that hog megafarms are improperly disposing of wastes. They claim that their wells have been contaminated. The Missouri Clean Water Commission is investigating.⁴³

In Florida, a golf club that was built across from an existing hog farm sued in 1998 to get the farmer to reduce the volume of the country music that he played to keep his hogs happy. In August 2000, the club decided to drop the suit and use a pig motif around the course. They said the volume had been reduced. They had also built a protective berm. The farmer insisted that he had not turned down the volume (although a judge ordered him to.)⁴⁴ He was outraged that he had wasted time and money on the suit.⁴⁵

⁴¹ Washington Post, August 2, 2000, p. A01.

⁴² Washington Post, August 16, 2000, p. B01.

⁴³ Kansas City Star, July 12, 2000.

⁴⁴ Associated Press, July 22, 2000.

⁴⁵ St. Petersburg Times, September 14, 2000.

Questions and Answers

A recent letter to the editor of *The State* (May 7, 2001) raised some questions that point out some possible opinions and misconceptions of the general public. Dr. John Chastain of Clemson University has given thoughtful answers to the questions.

The first question concerned the similarities between human and hog excrement given that hog heart valves are sometimes used in human surgery. Humans and swine have similar digestive tracts – both are monogastric animals. The main difference in the manure characteristics between hogs and people is their diet. If we could get people to eat a diet that consisted of 78% ground corn and 21% soybean meal then the manure would be basically the same.

The second question concerned the comparison of human communities and large hog farms. Using the 5-day biological oxygen demand (BOD₅) standard usually used by municipal treatment plants, an average weight finishing hog produces 0.43 BOD₅ per day and an average person produces 0.18 BOD₅ per day in bodily waste. If we add in other sources of BOD₅ that are associated with human activity (hospitals, food processing plants, factories, etc.), the per capita waste can double to 0.36 BOD₅. Thus one hog is the equivalent of 1.2 to 2.4 people in terms of loading on a waste treatment plant. SC regulations define a large finishing swine farm as a facility with more than 420,000 lb average live weight, which is the same as a facility that houses 3,000 head of finishing swine. A single 3,000-head finishing farm would provide the same daily BOD₅ load as 3,600 to 7,200 people. Considering the most recent estimates that the human population of SC is 4,012,012 and the hog population is 290,000, the humans produce about 6 to 12 times as much waste as the hogs.

The third question asks about the comparison between hog waste lagoons and municipal sewage loads. Both waste treatment processes are designed for the amount and kind of waste they treat.

The primary difference between municipal sewage and hog manure that can impact treatment is that hog manure does not contain large concentrations of heavy metals and other toxic substances that can occur in municipal sewage. Essentially, the only substances that exist in hog manure are the by-products of the feed fed to the animal. In the case of municipal sewage, the waste treatment plant operator has no idea when a toxic substance is flushed down the toilet or discharged into the system by a factory. Waste treatment operators often test for a variety of toxic substances to determine what they must deal with based on time of day and season of the year. Treatment lagoons were first used as a treatment process for municipal waste and are still often a component of municipal and industrial treatment systems. Anaerobic and facultative treatment lagoons for animal waste are designed based on the same concepts used for municipal lagoons. It is also important to remember that not all human waste is treated by municipal treatment plants. There are still over 700,000 septic tanks in

use in SC as well as over 200 human waste lagoons. This is not to argue the point that properly designed septic systems and human waste lagoons are not effective. They can be, just as a properly designed animal waste system can be.

The fourth question implies that hog waste is allowed to flow into the waters of the state. South Carolina law (The Standards for the Permitting of Agricultural Animal Facilities, R.61-43) prohibits the discharge of animal manure into waters of the state for any reason. Therefore, if you visit a hog farm that has a treatment lagoon you will not find a pipe or other source of discharge that connects the lagoon to any stream. Instead of discharging the effluent into a waterway, the lagoon water is used as a source of fertilizer (that is nitrogen, phosphorous, and potassium) for pastures, hay fields, or row crops. Current research at Clemson University is also investigating the use of animal manure as fertilizer for commercial pine plantations. In other words, animal producers try to gain benefit from manure by recycling the nutrients to grow plants that have economic value. Procedures for spreading animal manure must protect surface and ground water quality and be based on sound science.

South Carolina law requires the following:

- (1) samples must be collected on each farm each year to determine the amount of nitrogen, phosphorous, potassium, and other micro-nutrients contained in the manure,
- (2) the quantity of manure to apply to each acre must be determined based on the fertilizer recommendations for a particular crop as recommended by Clemson University Extension,
- (3) the application equipment must be calibrated each year so that the proper amount of manure is applied,
- (4) the farmer is required to maintain specific separation distances between where manure is land applied and waters of the state, and drinking water wells,
- (5) the farmer is required to maintain records of all manure sample results, spreader calibration records, and where and when swine manure is used to fertilize crops,
- (6) every farmer pays an annual permit fee to cover the cost of an annual inspection by SCDHEC, and
- (7) every swine producer that has received a permit under the current law is required to take a confined animal manure management certification course and pass a written exam within one year of receiving an operating permit.

The certification course is required by state law and is taught by Clemson University Extension. The course provides instruction on the proper use of animal manure as a fertilizer, management of manure treatment lagoons and storage structures, and methods to reduce odor.

Municipal waste treatment plants are designed to treat the liquid portion of the waste to the point where it can be discharged into a river. The permit for an individual treatment plant will specify the allowable concentrations of various substances that can be found in the effluent. The concentrations of

these pollutants are monitored frequently and if the concentrations exceed the allowable limits the plant is in violation. During periods of very high rainfall, municipal treatment plants often discharge partially treated wastewater into the river through a pipe. Swine farms must be designed to contain all the rainfall so as to prevent a discharge.

The solid part of the municipal or industrial waste stream, called biosolids or sludge, is often disposed of in a landfill. Land application of biosolids for fertilization of crop or forestland, and composting of biosolids is becoming more common. In some cases, municipal treatment plants have considered the idea of land applying the liquid portion of the waste to eliminate discharges to rivers and to increase the daily capacity of a plant without a major investment in new facilities. This would be a practice that is similar to what happens on hog farms and is better from a water pollution standpoint since the daily discharge of small amounts of pollutants into our rivers would be eliminated. However, the main deterrents to such practices are limited access to crop or forest land and concerns about maintenance of stream flow levels.

Since it is illegal and undesirable to design swine waste systems to discharge effluent to our rivers, then how much treatment is really needed on a hog farm? Water is used to remove the manure from the buildings on most swine farms – in many ways similar to a large toilet. A large fraction of the water used for cleaning the buildings can be recycled if the liquid portion of the waste stream from these buildings is treated well enough. A properly designed and managed treatment lagoon can provide this level of treatment. Therefore, as we look at new alternatives to treatment lagoons our goal is to define a cost-effective system that will provide a recyclable effluent. The other issue of great importance is odor. One of the main reasons for looking at treatment of hog manure is to reduce the level and frequency of odor.

The fifth question concerned the impact of increased treatment standards on the price of pork and on the profitability of smaller-scale hog farms. From an economics viewpoint, a universal requirement for stricter standards that increases the cost of producing pork will certainly raise the price of pork. Many studies have shown that the demand for food does not respond very much to price increases. Since other animals such as chickens and cattle are also covered by the regulations, their prices would also increase and there would be little movement from pork consumption to chicken or beef. Unless there is another source of pork such as cheap imports or large numbers of people become vegetarians, most of the cost increases would be passed along to consumers.

From an engineering standpoint, we have many treatment alternatives to use. However, many of these alternatives are very expensive and often provide more treatment than is needed. Another troubling point is that there are economies of scale for each technology. In general, as the cost and complexity of the treatment system increase, the farm size required to make it cost-effective also increases. The more complex systems often exclude the small farmer.

Some systems cost three times as much as a conventional lagoon system and are not cost-effective for any size farm. So instead of improving the profitability of the family farm, a requirement for municipal standards of treatment, would deal a further blow to them.

The final question wondered about allowing hog waste to negate the expensive progress made by our investment in municipal sewage treatment. Properly sited, designed, and managed hog farms should not negate the progress we have made in keeping our own waste out of the rivers. The siting requirements for hog farms – regardless of treatment option – are extensive. Examples of some of the requirements are given below.

- Hog farms cannot be built in the 100 year flood plain. Municipal plants are often built in flood plains to facilitate discharge.
- The minimum separation distance between a swine lagoon or storage pond and waters of the state varies from 500 ft to 2,640 ft depending on farm size and topography. Municipal plants and industrial waste treatment lagoons and other structures are routinely built next to a river.
- Land application of manure is limited based on the fertilizer needs of the crop and cannot be applied within 100 ft of waters of the state.
- Many other set-back distances are required by law relative to siting of swine facilities with respect to public and private drinking water wells, property lines, and distances from neighbor's residences. A complete copy of the regulations is available from the SC Department of Health and Environmental Control, Bureau of Water.

Other Sources of Pollution

Animal agriculture is certainly not the only polluter of America's waters. A recent internet search on the word "manure" turned up 58 news articles while a search at the same time on "sewage" turned up 355 news articles. Here are just a few of the stories concerning sewage spills and other pollution events.

The Tampa Tribune reported that a supervisor at a sewage treatment plant plead guilty to pumping untreated waste into a drainage canal for several hours. The man faces up to three years in prison and a \$250,000 fine.⁴⁶ In August 2000, the Macon (Georgia) Water Authority recorded its fourteenth sewage spill of the year, including thirteen major spills.⁴⁷ In Milwaukee, 123 million gallons of raw sewage mixed with rainwater were released into the Milwaukee, Menomonee and Kinnickinnic rivers following an August 2000 rainstorm. The sewage district released about 2.3 billion gallons of raw sewage in six dumps in 1999.⁴⁸ In San Diego 34,450 gallons of raw sewage leaked from a manhole cover and down a narrow alley over the course of nearly three days in late July 2000. It then flowed through a storm drain into the San Diego Bay requiring the closing of a public beach. This was the twenty-fourth time in 2000 that a raw sewage spill forced the closing of a beach in San Diego County.⁴⁹ Also in July 2000, a blocked pipe in Yosemite National Park caused 200,000 gallons of sewage to spill into the federally protected Merced River. The river was closed to swimming, fishing and other recreation for twelve miles downstream for three days.⁵⁰ In August 2000, an 800 gallon sewage spill at the Pirateland Swash near Myrtle Beach caused SC DHEC to post swim advisories along 1000 feet of beach.⁵¹

Sewage is not the only possible kind of pollution. On August 25, 2000, a worker at the Coors brewery in Golden, Colorado pushed the wrong button and sent 2,500 barrels of beer into a waste treatment facility at the plant. The beer was then flushed into Clear Creek. The fermenting agent in the beer killed the microorganisms that usually digest the organic matter so a large amount of organic matter entered the creek. Thousands of fish were killed.⁵²

⁴⁶ Tampa Tribune, August 10, 2000.

⁴⁷ Christopher Schwarzen, The Macon Telegraph, August 8, 2000.

⁴⁸ Gazette Extra, August 8, 2000.

⁴⁹ Terry Rodgers, San Diego Union-Tribune, August 1, 2000.

⁵⁰ Mark Grossi, Scripps-McClatchy Western Service, July 28, 2000.

⁵¹ Associated Press, August 17, 2000.

⁵² Gary Gerhardt, Denver Rocky Mountain News, August 26, 2000.

Sources of Funding for Farmers, Communities, and Others

http://www.epa.gov/earth1r6/6wq/at/nps/f_source.htm

Also see Catalog of Federal Funding Sources for Watershed Protection Second Edition

<http://www.epa.gov/owow/watershed/wacademy/fund.html>

U.S. EPA 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, leverage the funds and abilities of various partners, analyze cost effectiveness and how well the project really addresses the root cause of the water quality problem.

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>)

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%. 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 or; educating teachers, students or public about human health problems or; building state, local or tribal government capacity to develop environmental education programs or; educating community through community-based organization or; educating general public through print, film, broadcast or other media. Contact Ms. Jo Taylor (214/665-2204) with EPA Region 6.

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, leading to action to address those issues.

EPA Research Grants: 2000-01 Research Grants include topics such as research in environmental indicators, aggregate exposure assessment for pesticides, issues in human health risk assessment, nutrient fate and transport through watersheds, and technology for a sustainable environment. The list might differ from year to year. Information, forms, etc. may be obtained by consulting the EPA National Center for Environmental Research Web Page.

USDA Funding Sources

Natural Resources Conservation Service (NRCS)

Environmental Quality Incentives Program (EQIP): The EQIP provides cost sharing funds for land users 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 five to ten years. Contact your local NRCS office to apply.

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.

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.

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.

Farm Services Agency (FSA): The FSA Conservation Reserve Program Information 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 ten years or more.

Cooperative State Research, Education, and Extension Service (CSREES): 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 Fund for Rural America Program, 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 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.

USDA and EPA Joint Funding Sources

Sustainable Agriculture Research and Education Program (SAREP): The purpose of the SARE Program is to facilitate and increase scientific investigation and education to reduce the use of chemical pesticides, fertilizers, and toxic materials in agricultural production; to improve management of on-farm resources to enhance productivity, profitability, and competitiveness; to promote crop, livestock, and enterprise diversification and to facilitate the research of agricultural production systems located in areas that possess various soil, climatic, and physical characteristics; to study farms that have been and continue to be managed using farm practices that optimize the use of on-

farm resources and conservation practices; and to promote partnerships among farmers, nonprofit organizations, agribusiness, and public and private research and extension institutions.

Other Research Funding sources which may leverage with Water Quality Funds:

NCASI- National Council of the Paper Industry for Air and Stream

Improvement- This organization requests proposals apparently on a 2 year cycle for research projects related to sustainable forestry (Agenda 2020). Current priorities are Biotechnology, Basic Physiology, Soil Productivity and Remote Sensing. Although the main goal of these funds appears to be forest productivity, it may be possible to leverage these funds with others to develop a project with water quality improvement benefits also. Projects with 20% funding from non-federal sources may qualify for Department of Energy funding. Contact Information: Ms. Stephanie Jeffries, NCASI, P.O. Box 13318, Research Triangle Park NC 27709-3318 Phone: (919) 558-1983 Fax: (919) 558-1998