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Manure Nutrients Relative to the Capacity of Cropland and Pastureland to Assimilate Nutrients:

Spatial and Temporal Trends for the United States

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Executive Summary

Data from the Census of Agriculture were used to estimate livestock populations, quantities of manure produced, and land available for manure application for 1982, 1987, 1992, and 1997. Livestock include beef cattle, dairy cattle, swine, and poultry. A descriptive analysis is presented of the temporal and spatial changes in the number, size, and kind of livestock operations, and the changes in animal units, quantity of manure nutrients produced, land available for manure application, and excess manure nutrients at both the farm level and the county level.

The analysis shows that the structure of animal agriculture has changed dramatically over the last two decades. Small and medium-sized livestock operations have been replaced by large operations at a steady rate. The total number of livestock has remained relatively unchanged, but more livestock are kept in confinement. The number of confined animals per operation has increased for all major livestock types. A significant shift in the mix of livestock types occurred as dairy cattle decreased in number and poultry and swine populations increased. Livestock populations have become more spatially concentrated in high-production areas. The number of animal units per acre of land available on the farm for manure application for the largest operations is often high, averaging more than eight confined animal units per acre for large poultry and fattened cattle operations.

These changes in animal agriculture have resulted in increased problems associated with the utilization and disposal of animal waste. As livestock production has become more spatially concentrated, the amount of manure nutrients relative to the assimilative capacity of land available on farms for application has grown, especially in high production areas. Consequently, off-farm export requirements are increasing. In some counties the production of recoverable manure nutrients exceeds the assimilative capacity of all the cropland and pastureland available for manure application in the county. The number of these counties has significantly increased since 1982, indicating that problems associated with animal waste utilization and disposal have become more widespread over the last two decades as the structure of animal agriculture has shifted toward fewer, but larger livestock operations.

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Introduction

As the structure of animal agriculture has shifted toward fewer, but larger operations and as the percentage of animals in confinement has increased, utilization and disposal of animal waste has become an issue of environmental concern. Traditional agriculture recycled nutrients from animal manure by applying manure to cropland and pastureland to promote plant growth. This practice has the added benefit of improving soil quality; the addition of organic matter enhances soil structure and increases the soil's ability to hold water and resist compaction. With fewer, but larger operations, the amount of animal manure has become more concentrated in local areas. Because the distance that manure can be hauled for land application has practical limits, manure loadings per acre must either increase or alternative methods of utilization be adopted. When manure application rates exceed the capacity of the land to assimilate nutrients, repeated applications can lead to a buildup of nutrients in the soil. This increases the potential for nutrients to move from the field through leaching and runoff and to pollute ground and surface water.

Lander, Moffitt, and Alt evaluated the potential for cropping systems to assimilate manure nutrients and found that in 1992 there were several counties in the United States where nutrients from animal manure exceeded the capacity of the cropping systems to assimilate nutrients even if manure could be applied to all the suitable land in those counties (Lander, et al., 1998). Using published census of agriculture data for 1949 to 1992, Kellogg and Lander showed that the number of counties with "excess" manure nutrients increased from 1949 through 1964, remained stable until 1982, and then increased again through 1992 (Kellogg and Lander, 1999).

The specific objectives of this study are to:

- Quantify the shift in animal agriculture toward more concentrated production on fewer, but larger livestock operations since 1982.
- Quantify the extent to which livestock production has become more spatially concentrated.
- Quantify the production of animal manure and manure nutrients, and describe trends.
- Quantify the extent to which the production of manure nutrients may exceed the capacity of cropland and pastureland to assimilate nutrients.
- Identify counties that are likely to have animal waste utilization and disposal problems (thereby updating the previous analysis by Lander, Moffitt, and Alt) and describe how the number of these counties has changed over time.

Estimates were made using information from the census of agriculture for 1982, 1987, 1992, and 1997. Algorithms originally developed by Letson and Gollehon (Letson and Gollehon, 1998) and used by Lander, Moffitt, and Alt were modified to estimate the average annual number of livestock, the quantity of manure and manure nutrients produced, and the capacity of cropland and pastureland to assimilate nutrients. The resulting estimates are believed to be adequate for quantifying trends and assessing the magnitude and extent of the animal waste problem, but are not exact because of the numerous assumptions required to make the calculations.

This study is intended to serve as a compendium of results for use as a reference by other researchers and policy analysts and as a documentation of the methods used to make the estimates. The study is presented in two parts. The first part addresses the methodology and trends for estimates of animal numbers and operations according to farm size and livestock type. The second part addresses the methodology and trends for estimates of manure production and capacity of cropland and pastureland to assimilate manure nutrients. The study concludes with a summary of the trends observed.

Animal numbers and livestock operations

Using the census of agriculture data to estimate animal units per farm

Data from the census of agriculture were used to make estimates of livestock populations. A census of agricultural producers is conducted every 5 years by the USDA National Agricultural Statistics Service (NASS). (Prior to the 1997 Census, the census of agriculture was administered by the Bureau of the census, U.S. Department of Commerce.) The census is based on a questionnaire that all farms with more than $1,000 of agricultural product sales are required to submit. Electronic data bases of farm-level responses for 1982, 1987, 1992, and 1997 were used. (Access to this data base is restricted to protect the confidentiality of respondents. All estimates published in this study meet the disclosure criteria used by NASS to assure confidentiality.) Estimates were based on methods and parameters previously documented in Lander, Moffitt, and Alt, which are summarized here along with algorithm changes and parameter revisions.

The basic building block of the estimation process is an animal unit (AU). For the purposes of this study, an animal unit represents 1,000 pounds of live animal weight and serves as a common unit for aggregating over different types of livestock. The census of agriculture does not report the average number of animals on a farm during the year, which is needed to calculate animal units (and ultimately manure nutrients). Consequently, the annual average number of animal units on each farm was estimated using census information on sales and end-of-year inventories together with the set of assumptions and parameters presented later in this section. Estimates of animal units were made for beef, dairy, swine, and poultry. Estimates were not made for sheep, goats, horses, or other animal types.

Parameters and assumptions used to estimate animal units are appropriate only for farms that are involved in the commercial production and sale of livestock. It is thus necessary to exclude farms that produce only a small number of livestock either for home consumption or for sale at small, local markets. For purposes of this study, a *livestock operation* was defined to be a farm with at least three animal units or with more than $2,000 in sales of livestock products. The scope of the study was limited to farms meeting the criteria for a livestock operation. (In 1997, approximately 93,000 farms with a total of about 100,000 animal units did not meet the criteria for a livestock operation. These farms would not be expected to produce significant amounts of manure.)

For purposes of this study, the term *livestock* includes all beef, dairy, swine, and poultry.

Estimates of animal units were made for all livestock and for livestock held in confinement. Confined livestock are defined to be livestock held in a feedlot or other confinement facility such that sufficient amounts of manure would accumulate requiring removal on a regular basis. Confinement could be for the full life cycle, a portion of the life cycle, or some portion of the year. In the presentation of the results, estimates of animal units were aggregated to five major livestock types: fattened cattle, milk cows, other beef and dairy (consisting of cattle other than fattened cattle and milk cows), swine, and poultry.

Available data

The census of agriculture data base includes the following inventory and sales data on number of head of beef, dairy, swine, and poultry.

Cattle and calves

- Beef cow end-of-year inventory (including heifers that had calved)
- Milk cow end-of-year inventory (including dry milk cows and milk heifers that had calved)
- Heifer and heifer-calf end-of-year inventory (excluding heifers that had calved)
- Steers, steer calves, bulls, and bull calf end-of-year inventory
- Calves sold weighing less than 500 pounds
- Cattle and calves sold weighing more than 500 pounds
- Number of fattened cattle (500 pounds or more, fed grain or concentrates for 30 days or more) sold

Hogs and pigs

- Hogs and pigs used for breeding, end-of-year inventory
- Other hogs and pigs, end-of-year inventory

- Hogs and pigs sold, including feeder pigs
- Feeder pigs sold for further feeding

Poultry

- Chicken layers 20 weeks old and older, end-of-year inventory and number sold
- Pullets for laying flock replacement, 13 to 19 weeks old, end-of-year inventory
- Pullets for laying flock replacement, less than 13 weeks, end-of-year inventory
- Pullets of all ages sold
- Chicken broilers, fryers, and other meat-type chickens, end-of-year inventory and number sold
- Turkeys for slaughter, end-of-year inventory and number sold
- Turkey hens for breeding, end-of-year inventory and number sold

Conversion of head counts to animal units

The first step in converting data from the census to estimates of the annual average number of animal units on each farm is to convert head counts to animal units. The number of animals per animal unit, the degree of confinement, and the nutrient content of animal manure vary among livestock types as well as by maturity of the animal. Therefore, estimates were constructed for as many different livestock categories as possible given the information available from the census of agriculture. Sixteen livestock categories were derived (table 1). Animal unit conversions, also shown in table 1, were based on determinations of the *average* live weight associated with each livestock category**.** For some livestock categories (such as poultry), this represents the average weight from birth to market. For others, such as beef and dairy calves, it

Table 1 Summary of parameters used to calculate animal units for 16 livestock categories

Livestock category	Animals per animal unit	Cycles per year	Proportion of year on the farm
Fattened cattle	1.14	2.5	--
Milk cows	0.74	--	12/12
Other beef and dairy			
Beef calves, from calving to about 500 pounds	4	--	5/12
Beef heifers for replacement herds	1.14	--	5/12
Beef breeding herds (cows and bulls)	1	--	12/12
Beef stockers and grass fed beef	1.73	--	200/365*
Dairy calves, from calving to about 500 pounds	4	--	5/12
Dairy heifers for replacement herds	0.94	--	5/12
Dairy stockers and grass fed animals marketed as beef	1.73	--	200/365*
Swine			
Breeding hogs	2.67	--	12/12
Hogs for slaughter	9.09	2	--
Poultry			
Chickens, layers	250	--	12/12
Chickens, pullets			
Pullets less than 3 months old	455	2.25	--
Pullets more than 3 months old	250	2.25	--
Chickens, broilers	455	6	--
Turkeys for breeding	50	--	12/12
Turkeys for slaughter	67	2	--

* Stockers purchased (not raised from calves) were assumed to be on the farm for 100 days.

represents the average weight for the period that the animal was assumed to be in the specified category. Animal unit conversions were established to represent typical marketing practices for 1982 to 1997. No attempt was made to define animal unit conversions separately for each census year, although market weights have varied somewhat over this period. Average animal weights, and thus animal unit conversions, were derived in concert with manure characteristics. References to sources and methods are given in a later section.

General algorithm for estimating animal units

For each farm, the average number of animal units present during the year was estimated. Animal units for some categories (usually breeding stock) were estimated based only on end-of-year inventory. For these categories, it was assumed that there were no seasonal fluctuations in herd size and that there was continuous replacement. For categories with both sales and inventory data, a combination of data from end-of-year inventory and annual sales was used to estimate animal units. The general formula used is shown as equation 1 at the bottom of this page.

(An alternative rationale was used by Lander, Moffitt, and Alt for calculations involving both inventory and sales data. The minimum and maximum possible number of animals on the farm during the year was calculated and the average of the two taken to represent the average annual population. The maximum was determined by assuming that all sales represented animals on the farm from birth to market and the end-of-year inventory represented a minimum steady state population on the farm all year long. Thus, the maximum was sales/cycles plus inventory. The minimum was zero, which would be the case if all sales were made on the first day of the year and all inventory was purchased on the last day of the year, resulting in essentially no animals on the farm during the year. As it happens, this maximum-minimum algorithm and the one used in the present study are algebraically identical for the case where there are exactly two cycles per year, which is the case for hogs for slaughter and turkeys for slaughter.)

The general algorithm was obtained using the following simplifying assumptions:

- End-of-year inventory represents the partial cycle at the end of the year and the partial cycle at the beginning of the year, comprising a full cycle.
- Sales throughout the year do not fluctuate (i.e., no seasonal variation), and thus the average sales per cycle can be used to estimate the number of animals on the farm in each of the remaining cycles.

Essentially, inventory data were used to estimate AU for one cycle, and average sales data (sales per cycle) were used to estimate AU for the remaining cycles. For example, take the hypothetical case where three cycles of production are probable during a year and the livestock category spans from birth to market. Because the production cycle for a given farm probably did not begin exactly on the first day of the year, some of the sales represent animals that were on the farm in the last cycle of the previous year. These animals should not be counted as full AU for the current year. Similarly, the inventory present at the end of the year may be at the beginning of a cycle or near the end of a cycle. It is clear, however, that of the three cycles possible during a year, sales from two of the cycles were present on the farm from birth to market. Thus, the specific equation for this hypothetical example is shown as equation 2 at the bottom of this page.

$$\text{annual average AU} = \left\{\left(\text{inventory} \times \frac{1}{\text{cycles}}\right) + \left[\frac{\text{sales}}{\text{cycles}} \text{ x } \frac{(\text{cycles} - 1)}{\text{cycles}}\right]\right\} \times \text{AU conversion} \qquad \text{[eq. 1]}$$

$$\text{annual average AU} = \left\{\left(\text{inventory} \times \frac{1}{3}\right) + \left[\frac{\text{sales}}{3} \text{x} \left(\frac{2}{3}\right)\right]\right\} \times \text{AU conversion} \qquad \text{[eq. 2]}$$

Not all farms had both inventory and sales. Farms starting up a livestock operation sometimes had only end-of-year inventory, and farms going out of business or with production during times of the year other than the December 31 inventory date had sales, but no end-of-year inventory. For farms with inventory only, the animals were assumed to be in mid-cycle at the end of the year, and annual average AU was calculated as shown in equation 3 at the bottom of this page.

For farms that have only sales data, it was assumed that all the animals represented by sales were present on the farm throughout the period associated with the livestock category (e.g., from birth to market), and annual average AU was calculated as shown in equation 4:

[eq. 4]

$$\text{annual average AU} = \left(\frac{\text{sales}}{\text{cycles}}\right) \times \text{AU conversion}$$

For livestock categories (other than calves, heifers, and stockers) where sales data were used in the algorithms, an estimate of the number of cycles per year was required. For other livestock categories (breeding stock, calves, heifers, and stockers), an estimate was made of the percentage of the time the animal type would have been present on the farm. These parameters (table 1) were derived to represent general production practices across the Nation for all operations (large and small) for the period 1982 to 1997. For example, industry sources indicate that the time in a confined setting for fattened cattle ranges from 60 to 200 days, depending on season, cost of feed, and expected changes in sale price. The typical time in confinement for fattened cattle is 120 to180 days. A value of 2.5 cycles (146 days) was selected for fattened cattle to represent all operations. Similar information was evaluated to set these parameters for the other livestock categories. For any specific part of the country, farm size, or period, prevailing practices could result in different values for these parameters. However, the authors did not have the resources to estimate these parameters for each year, farm size class, and area of the country for this study.

The number of confined animal units per farm was obtained by multiplying the total animal units per farm by a confinement factor. Confinement factors varied according to the livestock category, the size of the livestock operation, and the region of the country to reflect differences in production technologies. All the animals were assumed confined for the largest operations. Table 2 presents the number of head (based on annual average livestock per farm) above which all of the animals were assumed to be confined. It was also assumed that none of the animals were confined on the small farms. Table 2 also presents the average number of head below which livestock on the farm were assumed **not** to be held in confinement. These cutoffs were derived by consulting with NRCS specialists on livestock agriculture around the country. Some of the animals were assumed to be confined (or confined for a portion of the time) on the remaining farms; confinement factors for these farms can be derived from the parameters in table 3. (See the section *Manure production and farmland assimilative capacity* for the derivation of combined confinement-recoverability factors.)

Estimates of animal units were made for the Nation, for the 50 states, and for counties or combinations of counties. In several cases it was necessary to combine counties to meet disclosure criteria. Because of the many assumptions used to estimate animal units, the more aggregated estimates are more likely to be the most accurate. In areas where the number of livestock operations are few, the chances are greater that the assumptions used in the modeling may not accurately represent those particular livestock operations (e.g., the number of cycles per year or confinement factors). Thus, estimates for counties with large numbers of operations or state and national estimates are expected to be more accurate. (With large numbers, both underestimation and overestimation are expected to occur for farms not meeting the assumptions, thus creating offsetting errors.)

The equations referred to in the following sections are shown in the boxed inset.

$$\text{annual average AU} = \left(\text{inventory} \times \frac{1}{2} \times \frac{1}{\text{cycles}}\right) \times \text{AU conversion} \qquad \text{[eq. 3]}$$

Table 2 Head-count thresholds for confinement factors

Livestock category	Source of data for number of head present on farm for at least a portion of the year	Average number of head below which all were assumed to not be confined	Average number of head above which all were assumed to be confined
Fattened cattle*			
Region 1	Total sales	15	200
Region 2	Total sales	15	300
Region 3	Total sales	15	400
Region 4	Total sales	15	500
Milk cows	Inventory	20	No lower limit
Other beef and dairy			
beef calves, from calving to about 500 pounds	Based on calving rate	20	No lower limit
beef heifers for replacement herds	Based on replacement rate	20	No lower limit
beef breeding herds (cows and bulls)	Inventory	20	No lower limit
beef stockers and grass fed beef	Inventory and sales	20	No lower limit
dairy calves, from calving to about 500 pounds	Based on calving rate	20	No lower limit
dairy heifers for replacement herds	Based on replacement rate	20	No lower limit
dairy stockers and grass fed animals marketed as beef	Inventory and sales	20	No lower limit
Swine			
breeding hogs	Inventory	10	50
hogs for slaughter	Inventory and/or sales adjusted for cycles	50	450
Poultry			
chickens, layers	Inventory or sales	50	400
chickens, pullets	Inventory and/or sales adjusted for cycles	25	400
chickens, broilers	Inventory and/or sales adjusted for cycles	100	400
turkeys for breeding	Inventory or sales	50	2,000
turkeys for slaughter	Inventory and/or sales adjusted for cycles	50	5,000

* States associated with each region are:
Region 1 CT, DE, ME, MD, MA, NH, NY, NJ, PA, RI, VT, WV, AL, GA, KY, MS, NC, SC, TN, and VA
Region 2 IL, IN, IA, MI, MN, MO, OH, and WI
Region 3 AR, LA, OK, TX, and FL
Region 4 CO, KS, MT, NE, ND, SD, WY, AK, AZ, CA, HI, ID, NV, NM, OR, UT, and WA

Table 3 Combined confinement-recoverability factors and manure recoverability factors by livestock category

State	Beef cows, calves, heifers, stockers	Dairy stockers	Fattened cattle	Milk cows and dairy calves	Breeding hogs	Hogs for slaughter	Chickens, layers	Chickens, pullets	Chickens, broilers	Turkeys for breeding	Turkeys for slaughter
Manure recoverability factor											
All states	0.98	0.98	0.90	0.98	0.95	0.95	0.98	0.98	0.98	0.98	0.98
Combined confinement and recoverability factors											
Alabama	0.00	0.05	0.70	0.40	0.75	0.75	0.95	0.95	0.98	0.85	0.85
Alaska	0.03	0.85	0.90	0.90	0.90	0.90	0.90	0.98	0.95	0.90	0.90
Arizona	0.05	0.75	0.85	0.80	0.85	0.85	0.90	0.90	0.90	0.65	0.65
Arkansas	0.10	0.50	0.50	0.50	0.50	0.50	0.80	0.80	0.95	0.70	0.70
California	0.05	0.75	0.85	0.80	0.85	0.85	0.90	0.90	0.90	0.95	0.95
Colorado	0.05	0.85	0.85	0.80	0.85	0.85	0.95	0.95	0.95	0.65	0.65
Connecticut	0.10	0.90	0.85	0.90	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Delaware	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Florida	0.00	0.20	0.00	0.50	0.40	0.40	0.95	0.95	0.95	0.85	0.85
Georgia	0.00	0.30	0.75	0.70	0.50	0.50	0.90	0.90	0.95	0.70	0.70
Hawaii	0.06	0.45	0.60	0.65	0.60	0.60	0.80	0.98	0.90	0.70	0.70
Idaho	0.00	0.80	0.85	0.95	0.70	0.70	0.98	0.98	0.98	0.20	0.20
Illinois	0.10	0.60	0.60	0.80	0.70	0.70	0.98	0.98	0.98	0.95	0.95
Indiana	0.10	0.50	0.75	0.60	0.80	0.80	0.95	0.95	0.95	0.95	0.95
Iowa	0.10	0.62	0.63	0.87	0.80	0.80	0.98	0.98	0.98	0.69	0.69
Kansas	0.05	0.60	0.75	0.85	0.80	0.80	0.95	0.95	0.95	0.75	0.75
Kentucky	0.08	0.70	0.70	0.70	0.60	0.60	0.80	0.80	0.80	0.80	0.80
Louisiana	0.00	0.10	0.80	0.50	0.80	0.80	0.98	0.98	0.98	0.80	0.80
Maine	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Maryland	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Massachusetts	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Michigan	0.08	0.80	0.75	0.90	0.66	0.66	0.98	0.98	0.98	0.45	0.45
Minnesota	0.15	0.80	0.90	0.90	0.85	0.85	0.98	0.98	0.98	0.40	0.40
Mississippi	0.10	0.50	0.75	0.60	0.65	0.65	0.90	0.90	0.95	0.85	0.85
Missouri	0.10	0.65	0.60	0.65	0.65	0.65	0.85	0.85	0.90	0.75	0.75
Montana	0.01	0.75	0.85	0.75	0.80	0.80	0.98	0.98	0.98	0.90	0.90
Nebraska	0.08	0.90	0.90	0.80	0.66	0.66	0.98	0.98	0.98	0.64	0.64
Nevada	0.05	0.75	0.85	0.80	0.85	0.85	0.90	0.90	0.90	0.65	0.65
New Hampshire	0.10	0.70	0.85	0.80	0.80	0.80	0.98	0.98	0.98	0.95	0.95
New Jersey	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
New Mexico	0.00	0.80	0.80	0.85	0.85	0.90	0.80	0.80	0.80	0.65	0.65
New York	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
North Carolina	0.00	0.00	0.75	0.59	0.90	0.90	0.98	0.98	0.98	0.98	0.98
North Dakota	0.00	0.60	0.85	0.80	0.50	0.50	0.85	0.85	0.85	0.85	0.85
Ohio	0.10	0.75	0.70	0.90	0.75	0.75	0.98	0.98	0.98	0.70	0.70
Oklahoma	0.00	0.65	0.80	0.65	0.75	0.75	0.98	0.98	0.98	0.80	0.80
Oregon	0.05	0.60	0.85	0.60	0.85	0.85	0.90	0.90	0.90	0.70	0.70

See notes at end of table.

Table 3 Combined confinement-recoverability factors and manure recoverability factors by livestock category—Continued

State	Beef cows, calves, heifers, stockers	Dairy stockers	Fattened cattle	Milk cows and dairy calves	Breeding hogs	Hogs for slaughter	Chickens, layers	Chickens, pullets	Chickens, broilers	Turkeys for breeding	Turkeys for slaughter
Pennsylvania	0.05	0.65	0.85	0.80	0.80	0.80	0.95	0.95	0.95	0.95	0.95
Rhode Island	0.10	0.70	0.85	0.80	0.80	0.80	0.90	0.90	0.95	0.95	0.95
South Carolina	0.00	0.59	0.80	0.59	0.49	0.49	0.98	0.98	0.98	0.85	0.85
South Dakota	0.10	0.60	0.75	0.80	0.70	0.70	0.95	0.95	0.95	0.80	0.80
Tennessee	0.10	0.50	0.75	0.60	0.65	0.65	0.90	0.90	0.95	0.85	0.85
Texas	0.05	0.50	0.85	0.75	0.98	0.98	0.98	0.98	0.98	0.80	0.98
Utah	0.05	0.75	0.85	0.80	0.85	0.85	0.90	0.90	0.90	0.65	0.65
Vermont	0.20	0.90	0.90	0.90	0.80	0.80	0.90	0.90	0.95	0.95	0.95
Virginia	0.10	0.70	0.85	0.60	0.80	0.80	0.98	0.98	0.98	0.98	0.98
Washington	0.05	0.75	0.85	0.80	0.85	0.85	0.90	0.90	0.90	0.65	0.65
West Virginia	0.00	0.70	0.98	0.80	0.75	0.75	0.98	0.98	0.98	0.98	0.98
Wisconsin	0.08	0.75	0.70	0.90	0.66	0.66	0.98	0.98	0.98	0.70	0.70
Wyoming	0.05	0.70	0.80	0.80	0.75	0.75	0.95	0.95	0.95	0.75	0.75

Notes: The combined confinement and recoverability factors represent the proportion of manure produced that is recoverable and available for land application for farms other than the smallest and largest operations. The recoverability factors are proportions of manure that can be recovered for all confined animals.

Combined confinement-recoverability factors for dairy heifers for herd replacement were calculated as the average of factors for dairy cows and beef cows.

Values in this table are based on those previously published by Lander, Moffitt, and Alt (1998), tables A-9 and A-10, with only minor refinements.

Confinement factors can be determined by dividing the combined confinement-recoverability factors by the recoverability factor in the first row. For example, the confinement factor for turkeys for slaughter in Alabama would be 0.85/0.98=0.87.

Algorithm for fattened cattle

Animal units for fattened cattle were calculated using data on the number of fattened cattle sold and an assumption about the number of cycles of fattened cattle that would be likely during a year. It was assumed that fattened cattle would be on the farm for about 140 to 150 days, equating to 2.5 cycles per year. Assuming there are 1.14 fattened cattle per animal unit during this feeding period, the annual average number of fattened cattle AU per farm was calculated as shown in equation 5.

Algorithm for milk cows

Animal units for milk cows were based on the end-of-year inventory for milk cows as reported in the census of agriculture and the assumption that there are 0.74 animals per animal unit. Thus, the annual average number of milk cow AU per farm was calculated as shown in equation 6.

Algorithms for swine

The annual average number of AU per farm for breeding hogs was based on end-of-year inventory and the assumption that there are 2.67 animals per animal unit (equation 7). For hogs for slaughter, data from end-of-year inventory and from annual sales were used to estimate annual average animal units (equations 8–10). Two cycles per year were assumed likely for the average continuous production facility, and the animal unit conversion was 9.09 (representing a birth-to-market average weight). Sales data were hog and pig sales less feeder pig sales. Feeder pig sales were excluded because they show up as final sales for other farms.

Fattened cattle [eq. 5]

$$\text{Fattened cattle AU} = \frac{\left(\frac{\text{fatten cattle sales}}{2.5}\right)}{1.14}$$

Milk cows [eq. 6]

$$\text{Milk cow AU} = \frac{\text{milk cow inventory}}{0.74}$$

Hogs for breeding [eq. 7]

$$\text{AU} = \frac{\text{breeding hog inventory}}{2.67}$$

Hogs for slaughter:

Farms with both inventory and sales data [eq. 8]

$$\text{AU} = \frac{\left\{\left(\text{other hog and pig inventory} \times \frac{1}{2}\right) + \left[\frac{\text{sales}}{2} \times \left(\frac{1}{2}\right)\right]\right\}}{9.09}$$

Farms with only inventory data [eq. 9]

$$\text{AU} = \frac{\left(\text{other hog and pig inventory} \times \frac{1}{2} \times \frac{1}{2}\right)}{9.09}$$

Farms with only sales data [eq. 10]

$$\text{AU} = \frac{\left(\frac{\text{sales}}{2}\right)}{9.09}$$

Algorithms for poultry

The five livestock categories for poultry are layers, pullets, broilers, turkeys for breeding, and turkeys for slaughter. Animal units for layers and turkeys for breeding were estimated using algorithms similar to those used for hogs for breeding except that sales data were also used for farms without end-of-year inventory. Thus, it was assumed that these populations were in a steady state throughout the year with continuous replacement to offset mortality and sale of animals no longer productive. Animal unit conversions were 250 animals per AU for layers and 50 for turkeys for breeding. Some farms reported sales of layers or turkeys for breeding, but had no inventory at the end of the year. Since it is not known how long those animals were actually on the farm, sales data were divided by two under the assumption that sales were continuous throughout the year (and thus animals were on the farm half the year on average). Annual average AU per farm was calculated as shown in equations 11 through 14.

Animal units for pullets, broilers, and turkeys for slaughter were estimated using algorithms similar to those used for slaughter hogs. It was assumed that facilities in continuous production would have 2.25 cycles per year for pullets, 6 cycles per year for broilers, and 2 cycles per year for turkeys for slaughter. Animal unit conversions were 250 for pullets older than 13 weeks, 455 for broilers and pullets less than 13 weeks, and 67 for turkeys for slaughter. For pullet sales, the animals were assumed to be about 17 weeks old with an animal unit conversion of 404 (13 weeks at 455 and 4 weeks at 250). Annual average AU per farm was calculated as shown in equations 15 through 23.

Poultry

Chicken layers

Farms with end-of-year inventory [eq. 11]

$$AU = \frac{\text{layer inventory}}{250}$$

Farms with sales but no end-of-year inventory [eq. 12]

$$AU = \frac{\left(\frac{\text{sales of layers}}{2}\right)}{250}$$

Breeding turkeys

Farms with end-of-year inventory [eq. 13]

$$AU = \frac{\text{turkey hens for breeding inventory}}{50}$$

Farms with sales but no end-of-year inventory [eq. 14]

$$AU = \frac{\left(\frac{\text{sales of turkey hens for breeding}}{2}\right)}{50}$$

Chicken pullets

Farms with both inventory and sales data [eq. 15]

$$AU = \frac{\left(\text{inventory of pullets older than 13 weeks} \times \frac{1}{2.25}\right)}{250} + \frac{\left(\text{inventory of pullets younger than 13 weeks} \times \frac{1}{2.25}\right)}{455} + \frac{\left[\frac{\text{pullet sales}}{2.25} \times \left(\frac{1.25}{2.25}\right)\right]}{405}$$

Farms with with only inventory data [eq. 16]

$$AU = \frac{\left(\text{inventory of pullets older than 13 weeks} \times \frac{1}{2} \times \frac{1}{2.25}\right)}{250} + \frac{\left(\text{inventory of pullets younger than 13 weeks} \times \frac{1}{2} \times \frac{1}{2.25}\right)}{455}$$

Poultry (continued)

Chicken pullets (continued)

Farms with only sales data [eq. 17]

$$AU = \frac{\left(\frac{\text{pullet sales}}{2.25}\right)}{405}$$

Chicken broilers

Farms with both inventory and sales data [eq. 18]

$$AU = \frac{\left\{\left(\text{broiler inventory} \times \frac{1}{6}\right) + \left[\frac{\text{broiler sales}}{6} \times \left(\frac{5}{6}\right)\right]\right\}}{455}$$

Farms with only inventory data [eq. 19]

$$AU = \frac{\left(\text{broiler inventory} \times \frac{1}{2} \times \frac{1}{6}\right)}{455}$$

Farms with only sales data [eq. 20]

$$AU = \frac{\left(\frac{\text{broiler sales}}{6}\right)}{455}$$

Slaughter turkeys

Farms with both inventory and sales data [eq. 21]

$$AU = \frac{\left\{\left(\text{slaughter turkey inventory} \times \frac{1}{2}\right) - \left[\frac{\text{slaughter turkey sales}}{2} \times \frac{1}{2}\right]\right\}}{67}$$

Farms with only inventory data [eq. 22]

$$AU = \frac{\left(\text{slaughter turkey inventory} \times \frac{1}{2} \times \frac{1}{2}\right)}{67}$$

Farms with only sales data [eq. 23]

$$AU = \frac{\left(\frac{\text{slaughter turkey sales}}{2}\right)}{67}$$

Algorithms for other beef and dairy cattle

The last seven livestock categories include beef and dairy calves, heifers for replacement herds, beef breeding herds, and the remainder of cattle that are largely grass fed for market or are stockers that eventually end up as fattened cattle. These livestock types are generally confined only during part of the year or not at all. Algorithms were constructed so as to exhaust all the cattle listed for the farm as either:

- heifer and heifer calf inventory,
- steer, steer calf, bull, and bull calf inventory,
- cattle less than 500 pounds sold, or
- cattle more than 500 pounds sold less fattened cattle.

Beef breeding herds were estimated by adding beef cow inventory to an estimate of the number of bulls that would be expected to be associated with the beef cows. It was assumed that the number of bulls was equal to 5 percent of the number of beef cows as long as that estimate was less than or equal to the end-of-year inventory for steers and bulls. Where this was not the case, the number of bulls was set equal to the steer and bull inventory under the assumption that no steers were present. Beef cow herds were assumed to be in steady state with continuous replacement, and the animal unit conversion was 1 (equations 24 and 25).

Beef and dairy calves were estimated based on assumptions about calving rates and the number of calves sold. Calving rates were assumed to be 82 percent for beef and 65 percent for dairy. It was assumed that calves were in this category for 5 months if on the farm

Other beef and dairy cattle

Beef breeding herds

Bulls [eq. 24]

Bulls = minimum of:

$$(0.05 \times \text{beef cow inventory}) \text{ or } (\text{steer and bull inventory})$$

Beef cow breeding herd [eq. 25]

$$\text{AU} = \frac{(\text{beef cow inventory}) + (\text{bulls})}{1}$$

Beef and dairy calves

Farms with beef cows but no milk cows (assumed all cattle were beef)

Expected beef calves [eq. 26]

$$\text{Expected beef calves} = \text{beef cow inventory} \times 0.82$$

Purchased and sold [eq. 27]

Purchased and sold beef calves =

$$(\text{sale of cattle less than 500 pounds}) - (\text{expected beef calves})$$

Beef calf AU [eq. 28]

$$\text{AU} = \frac{\left[\left(\text{expected beef calves} \times \frac{5}{12}\right) + \left(\text{purchased and sold beef calves} \times \frac{2.5}{12}\right)\right]}{4}$$

Farms with milk cows but no beef cows (assumed all cattle were dairy)

Expected dairy calves [eq. 29]

$$\text{Expected dairy calves} = \text{milk cow inventory} \times 0.65$$

Purchased and sold [eq. 30]

Purchased and sold dairy calves =

$$(\text{sale of cattle less than 500 pounds}) - (\text{expected dairy calves})$$

Dairy calf AU [eq. 31]

$$\text{AU} = \frac{\left[\left(\text{expected dairy calves} \times \frac{5}{12}\right) + \left(\text{purchased and sold dairy calves} \times \frac{2.5}{12}\right)\right]}{4}$$

from birth and 2.5 months if evidence showed that calves were purchased and later sold. If the number of calves sold exceeded the number of calves expected using the calving rate, the additional calves sold were assumed to have been purchased as young calves and later sold. For farms that had both dairy and beef animals, calves were first allocated to dairy and the remainder allocated to beef. Purchased calves were classified as beef. The animal unit conversion for calves was 4. Annual average AU for beef and dairy calves was calculated as shown in equations 26 to 35.

Beef and dairy heifers for replacement herds were estimated based on assumptions about replacement rates and heifer and heifer-calf end-of-year inventory. The number of heifers for replacement herds was assumed equal to 15 percent of the number of beef cows and 20 percent of the number of milk cows as long as that estimate was less than or equal to the end-of-year inventory for heifers and heifer calves. Where it was more, the number of replacement heifers was set equal to the heifer and heifer-calf end-of-year inventory. For farms that had both dairy and beef animals, heifers were first allocated to dairy and the remainder allocated to beef. Heifers for replacement herds were assumed to be in this category for 5 months. The animal unit conversion was 1.14 for beef and 0.94 for dairy. Annual average AU for beef and dairy heifers for replacement herds was calculated as shown in equations 36 to 41.

Other beef and dairy cattle (continued)

Beef and dairy calves (continued)

Farms with both beef and milk cows

Expected dairy calves [see eq. 29]

Dairy calf AU [eq. 32]

$$AU = \frac{\left(\text{expected dairy calves} \times \frac{5}{12}\right)}{4}$$

Expected beef calves [see eq. 26]

Purchased and sold beef calves [eq 33]

$$\text{Purchased and sold beef calves} = \left(\text{sale of cattle less than 500 pounds}\right) - \left(\text{expected dairy and beef calves}\right)$$

Beef calf AU [eq. 34]

$$AU = \frac{\left[\left(\text{expected beef calves} \times \frac{5}{12}\right) + \left(\text{purchased and sold beef calves} \times \frac{2.5}{12}\right)\right]}{4}$$

Farms with no beef or milk cows but with sales of cattle less than 500 pounds (assumed all were purchased and sold)

Beef calf AU [eq. 35]

$$AU = \frac{\left(\text{sale of cattle less than 500 pounds} \times \frac{2.5}{12}\right)}{4}$$

Beef and dairy heifers for replacement herds

Farms with beef cows but no milk cows (assumed all cattle were beef)

Beef replacement herd heifers [eq. 36]

$$\text{Beef replacement herd heifers} = \text{minimum of: } \left(0.15 \times \text{beef cow inventory}\right) \text{ or } \left(\text{heifer inventory}\right)$$

Beef replacement herd heifer AU [eq. 37]

$$AU = \frac{\left(\text{beef replacement herd heifers} \times \frac{5}{12}\right)}{1.14}$$

Cattle raised as grass-fed beef and as stockers for fattened cattle operations were estimated as the residual number of cattle on the farm after accounting for the livestock categories already mentioned. Animals on farms with both beef and dairy were classified as beef. Beef and dairy replacement herd heifers were used as proxy estimates for beef and dairy cows sold. Equations 42 to 49 were used to estimate the residual number of animals, labeled *beef stockers* and *dairy stockers*. These animals were assumed to be in this category for 200 days if raised on the farm or 100 days if purchased and sold. If the number of stockers sold plus the stocker end-of-year inventory exceeded the number of these animals produced on the farm (based on the estimate of calves produced on the farm), it was assumed that the additional cattle sold had been purchased and later sold. The animal unit conversion for these two categories was 1.73. Annual average AU was then calculated as shown in equations 50 to 56.

Other beef and dairy cattle (continued)

Beef and dairy heifers for replacement herds

Farms with milk cows but no beef cows (assumed all cattle were dairy)

Dairy replacement herd heifers [eq. 38]

Dairy replacement heifers = minimum of:

$$(0.20 \times \text{milk cow inventory}) \text{ or } (\text{heifer inventory})$$

Dairy replacement heifer AU [eq. 39]

$$\text{AU} = \frac{\left(\text{dairy replacement herd heifers} \times \frac{5}{12}\right)}{0.94}$$

Farms with both beef and milk cows

Dairy replacement herd heifers [see eq. 38]

Beef heifer inventory [eq. 40]

Beef heifer inventory =

$$(\text{heifer inventory}) - (\text{dairy replacement herd heifers})$$

Beef replacement herd heifers [eq. 41]

Beef replacement herd heifers = minimum of:

$$(0.15 \times \text{beef cow inventory}) \text{ or } (\text{beef heifer inventory})$$

Beef replacement heifer AU [see eq. 37]

Grass-fed beef and stockers, intermediate calculations

Farms with beef cows but no milk cows (assumed all cattle were beef)

Beef cows sold [eq. 42]

Beef cows sold = beef replacement herd heifers

Beef stockers sold [eq. 43]

$$\text{Beef stockers sold} = (\text{cattle more than 500 pounds sold}) - (\text{fattened cattle sold}) - (\text{beef cows sold})$$

Beef stockers inventory [eq. 44]

Beef stockers inventory =

$$(\text{heifer inventory}) - (\text{beef replacement herd heifers}) + (\text{steer and bull inventory}) - (\text{bulls})$$

Other beef and dairy cattle (continued)

Grass-fed beef and stockers, intermediate calculations (continued)

Farms with milk cows but no beef cows (assumed all cattle were dairy)

Dairy cows sold [eq. 45]

$$\text{Dairy cows sold} = \text{dairy replacement herd heifers}$$

Dairy stockers sold [eq. 46]

$$\text{Dairy stockers sold} = (\text{cattle more than 500 pounds sold}) - (\text{fattened cattle sold}) - (\text{dairy cows sold})$$

Dairy stockers inventory [eq. 47]

Dairy stockers inventory =

$$(\text{heifer inventory}) - (\text{dairy replacement herd heifers}) + (\text{steer and bull inventory})$$

Farms with beef and milk cows

Beef cows sold [see eq. 42]

Dairy cows sold [see eq. 45]

Beef stockers sold [eq. 48]

Beef stockers sold =

$$(\text{cattle more than 500 pounds sold}) - (\text{fattened cattle sold}) - (\text{beef and dairy cows sold})$$

Beef stockers inventory [eq. 49]

Beef stockers inventory =

$$(\text{heifer inventory}) - (\text{beef and dairy replacement herd heifers}) + (\text{steer and bull inventory}) - (\text{bulls})$$

Grass-fed beef and stockers, final calculations

Farms with beef cows (with or without milk cows)

Purchased and sold beef stockers [eq. 50]

$$\text{Purchased and sold beef stockers} = (\text{beef stockers sold}) + (\text{beef stocker inventory}) - (\text{expected beef calves})$$

Beef stocker AU [eq. 51 & 52]

If $\text{expected beef calves} \geq (\text{beef stockers sold}) + (\text{beef stocker inventory})$, then:

$$\text{Beef stocker AU} = \left[(\text{beef stockers sold}) + (\text{beef stocker inventory})\right] \times \frac{200}{365}$$

If $\text{expected beef calves} < (\text{beef stockers sold}) + (\text{beef stocker inventory})$, then:

$$\text{Beef stocker AU} = \frac{\left[\left(\text{expected beef calves} \times \frac{200}{365}\right) + \left(\text{purchased and sold beef stockers} \times \frac{100}{365}\right)\right]}{1.73}$$

Other beef and dairy cattle (continued)

Grass-fed beef and stockers, final calculations (continued)

Farms with milk cows but no beef cows

Purchased and sold dairy stockers [eq. 53]

Purchased and sold dairy stockers =

$$(\text{dairy stockers sold}) + (\text{dairy stocker inventory}) - (\text{expected dairy calves})$$

Dairy stocker AU [eq. 54 & 55]

If expected dairy calves $\geq (\text{dairy stockers sold}) + (\text{dairy stocker inventory})$, then:

$$\text{Dairy stocker AU} = \left[(\text{dairy stockers sold}) + (\text{dairy stocker inventory})\right] \times \frac{200}{365}$$

If expected dairy calves $< (\text{dairy stockers sold}) + (\text{dairy stocker inventory})$, then:

$$\text{Dairy stocker AU} = \frac{\left[\left(\text{expected dairy calves} \times \frac{200}{365}\right) + \left(\text{purchased and sold dairy stockers} \times \frac{100}{365}\right)\right]}{1.73}$$

Farms with no beef cows or milk cows but with stocker sales or inventory (assumed all were purchased and sold)

Beef stocker AU [eq. 56]

$$\text{Beef stocker AU} = \frac{\left[(\text{beef stockers sold}) + (\text{beef stocker inventory}) \times \frac{100}{365}\right]}{1.73}$$

Status and trends

Animal units were calculated for each farm according to the methods presented in the last section. For analysis of status and trends, animal units were aggregated according to the five major livestock types and by farm size class for all animal units and for confined animal units.

Results show that the structure of animal agriculture changed dramatically between 1982 and 1997 as the number of livestock operations fell and the number of animal units became more concentrated on fewer but larger operations. The total number of livestock operations steadily decreased from 1,385,205 in 1982 to 1,048,731 in 1997, a 24 percent decrease (table 4, fig. 1). About half of the livestock operations had confined livestock, and thus had accumulations of manure requiring removal and disposal. Livestock operations with confined livestock similarly fell 27 percent.

Figure 1 Livestock operations

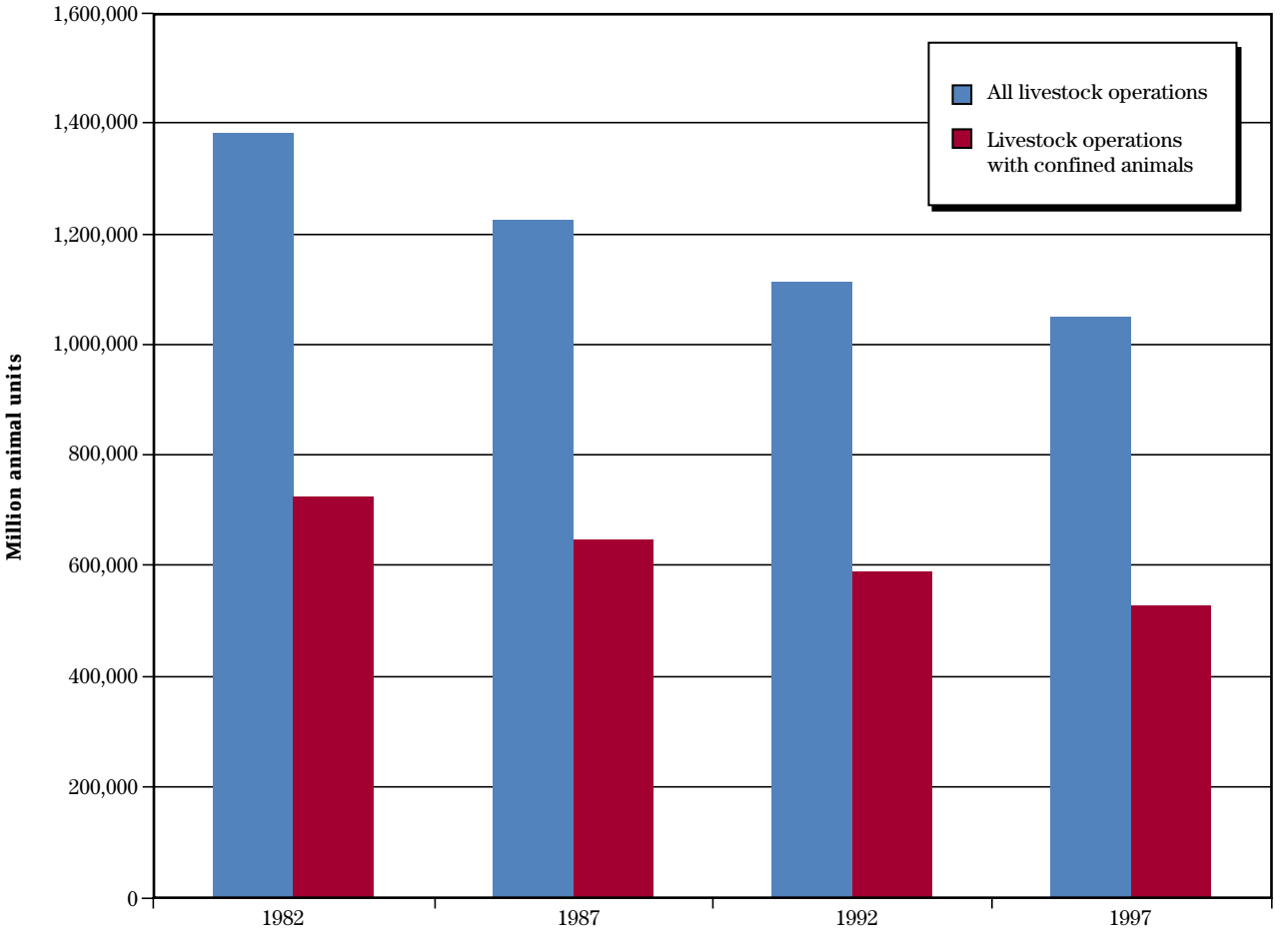


Table 4 Number of livestock operations and animal units (AU) by farm size, 1982-1997*

Farm size category	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
			Number of livestock operations			
Farms with less than 25 total AU	660,425	577,488	496,206	472,335	–188,090	28
Farms with 25 to <50 total AU	263,355	233,366	217,423	203,402	–59,953	–23
Farms with 50 to <150 total AU	336,505	297,081	275,128	246,220	–90,285	–27
Farms with 150 to <300 total AU	84,041	79,952	80,178	77,219	–6,822	–8
Farms with 300 to <1000 total AU	35,437	35,697	38,666	41,534	6,097	+17
Farms with 1000 or more total AU	5,442	5,757	6,526	8,021	2,579	+47
All livestock operations	1,385,205	1,229,341	1,114,127	1,048,731	–336,474	–24
			Number of animal units on livestock operations			
Farms with less than 25 total A	7,311,927	6,406,057	5,727,476	5,407,009	–1,904,918	–26
Farms with 25 to <50 total AU	9,465,723	8,379,402	7,797,699	7,277,610	–2,188,113	–23
Farms with 50 to <150 total AU	29,009,019	25,722,744	23,961,311	21,460,328	–7,548,691	–26
Farms with 150 to <300 total AU	17,142,530	16,352,605	16,483,027	15,967,020	–1,175,510	–7
Farms with 300 to <1000 total AU	16,912,228	17,061,674	18,603,343	20,271,518	3,359,290	+20
Farms with 1000 or more total AU	15,779,144	17,285,205	19,364,252	24,925,729	9,146,585	+58
All livestock operations	95,620,570	91,207,687	91,937,108	95,309,215	–311,355	0
			Number of livestock operations with confined livestock			
Farms with less than 25 total AU	112,732	97,507	75,425	57,061	–55,671	–49
Farms with 25 to <50 total AU	199,300	177,798	162,929	150,130	–49,170	–25
Farms with 50 to <150 total AU	302,934	265,272	241,216	209,670	–93,264	–31
Farms with 150 to <300 total AU	76,735	72,600	72,295	68,279	–8,456	–11
Farms with 300 to <1000 total AU	31,930	32,214	34,841	37,093	5,163	+16
Farms with 1000 or more total AU	4,908	5,274	6,004	7,425	2,517	+51
All livestock operations	728,539	650,665	592,710	529,658	–198,881	–27
			Number of confined animal units on livestock operations			
Farms with less than 25 total AU	594,633	522,322	397,372	213,395	–381,238	–64
Farms with 25 to <50 total AU	1,943,360	1,650,818	1,321,447	916,360	–1,027,000	–53
Farms with 50 to <150 total AU	11,541,927	10,170,286	8,738,482	6,599,352	–4,942,575	–43
Farms with 150 to <300 total AU	6,873,725	6,731,711	6,721,739	6,069,409	–804,316	–12
Farms with 300 to <1000 total AU	5,989,492	6,442,824	7,182,037	8,150,968	2,161,476	+36
Farms with 1000 or more total AU	8,543,885	10,180,675	11,749,709	16,093,217	7,549,332	+88
All livestock operations	35,487,021	35,698,636	36,110,787	38,042,702	2,555,681	+7

* A livestock operation is defined to be a farm that has more than 3 animal units or total livestock sales of more than $2,000. Livestock include fattened cattle, milk cows, other beef and dairy, swine, and poultry.

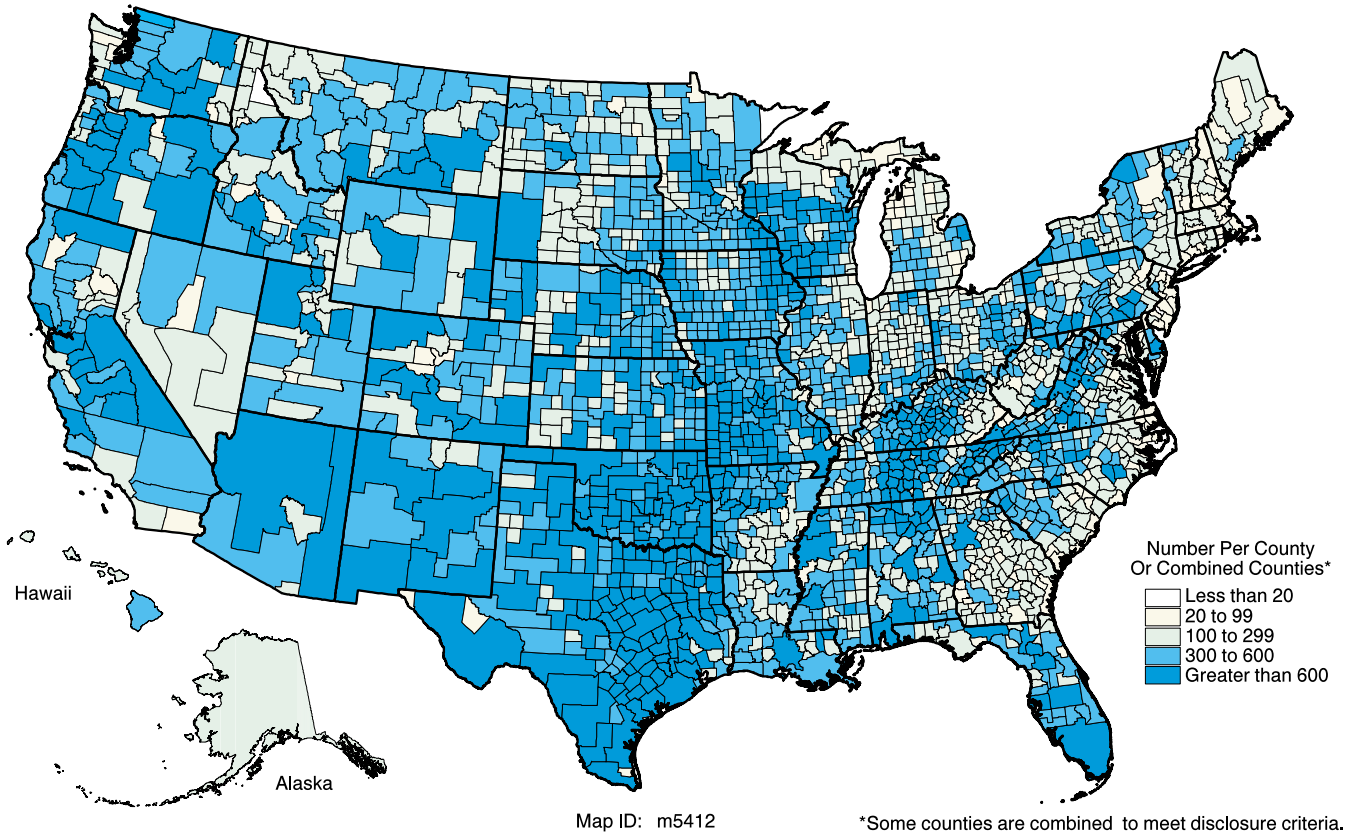
Notes: Size classes are based on total animal units on farms, including both confined livestock and livestock not held in confinement.

A breakdown of the number of livestock operations and animal units by farm size and livestock type is provided in appendix A. State estimates are provided in appendix B.

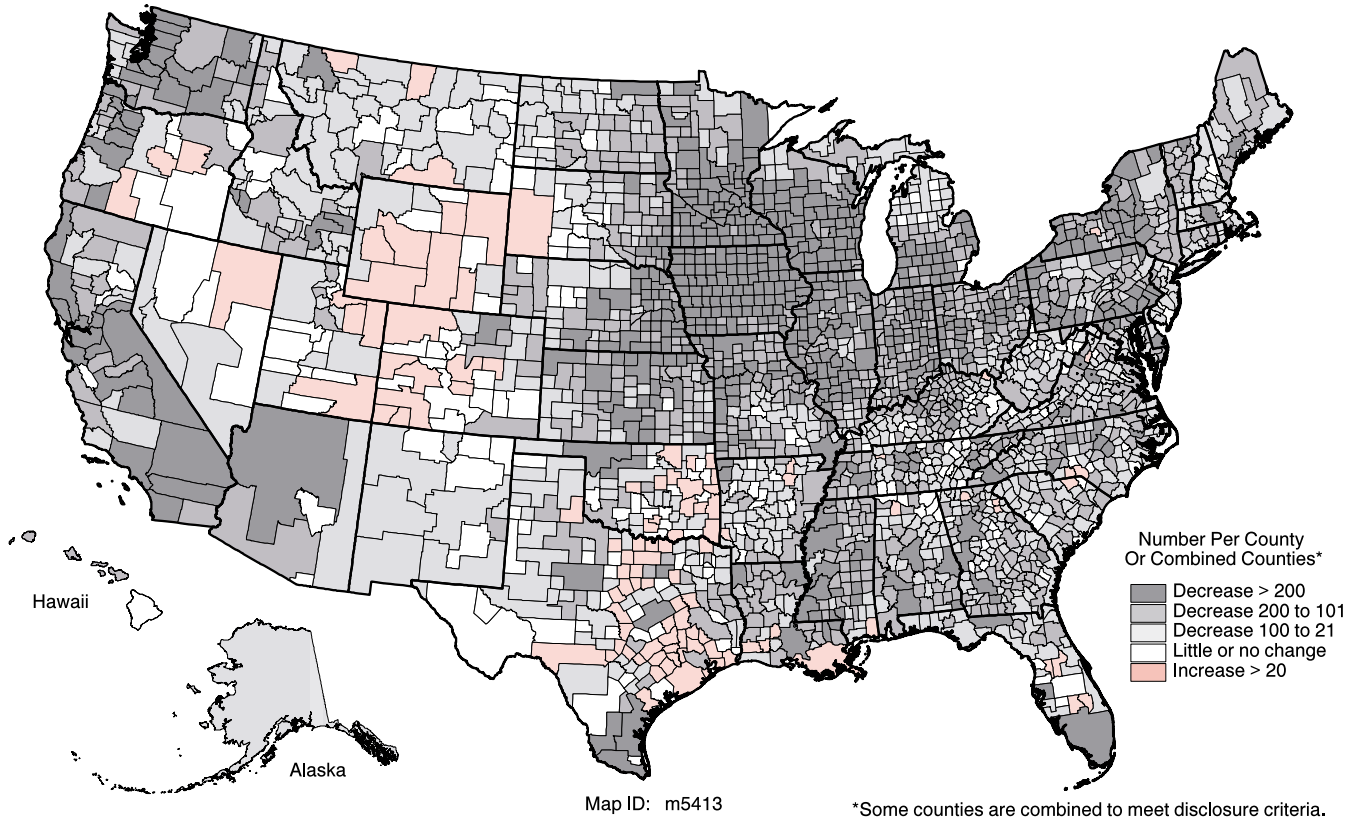
The spatial distribution of livestock operations in 1997 is shown in map 1. Areas with large decreases in the number of operations (map 2) between 1982 and 1997 are, in general, the central northern States stretching from New York to eastern Nebraska, west coast States and Arizona, and in scattered areas throughout the Southeast. The number of livestock operations in areas in eastern Texas, Oklahoma, and the Mountain States actually increased. The distribution of operations with confined livestock is similar to that for all livestock, but areas of concentration are more pronounced (maps 3 and 4). Loss of operations with confined livestock was most concentrated in Iowa and States bordering Iowa. New York, Pennsylvania, Arizona, California, and Washington also had areas where the loss of operations with confined livestock was high.

All the maps have a certain amount of bias caused by the size variability among counties. Combining counties to meet disclosure criteria contributes to this size bias. Large counties tend to be placed in higher classes simply because there are more units (number of farms, animal units) in large counties, not necessarily because the number of units per area are higher. (Maps of units per area correct this bias, but do not convey information on relative magnitudes.) A large county (or set of combined counties) in the West has the same analytical significance as the small counties in the Midwest and East.

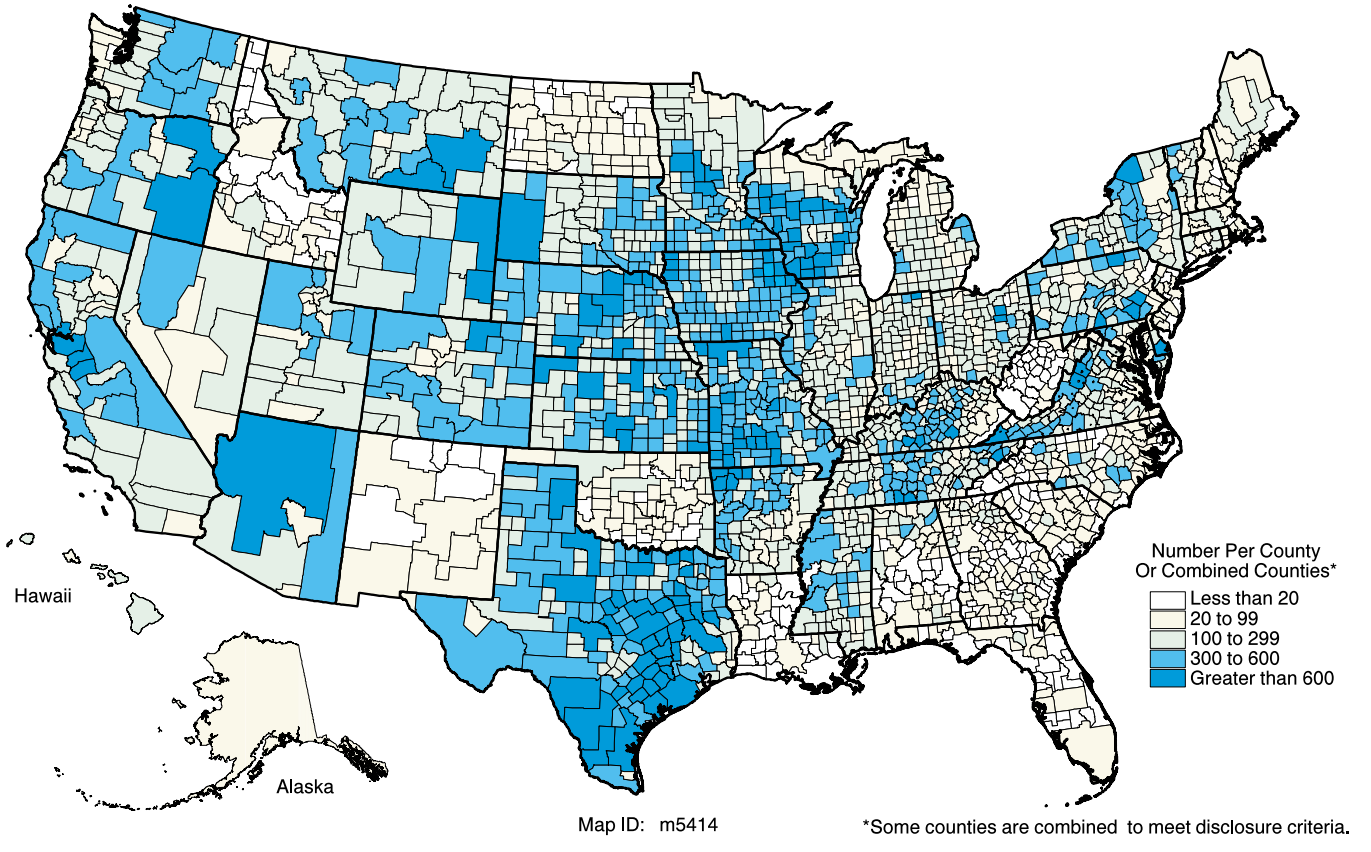
Map 1 Number of livestock operations, 1997



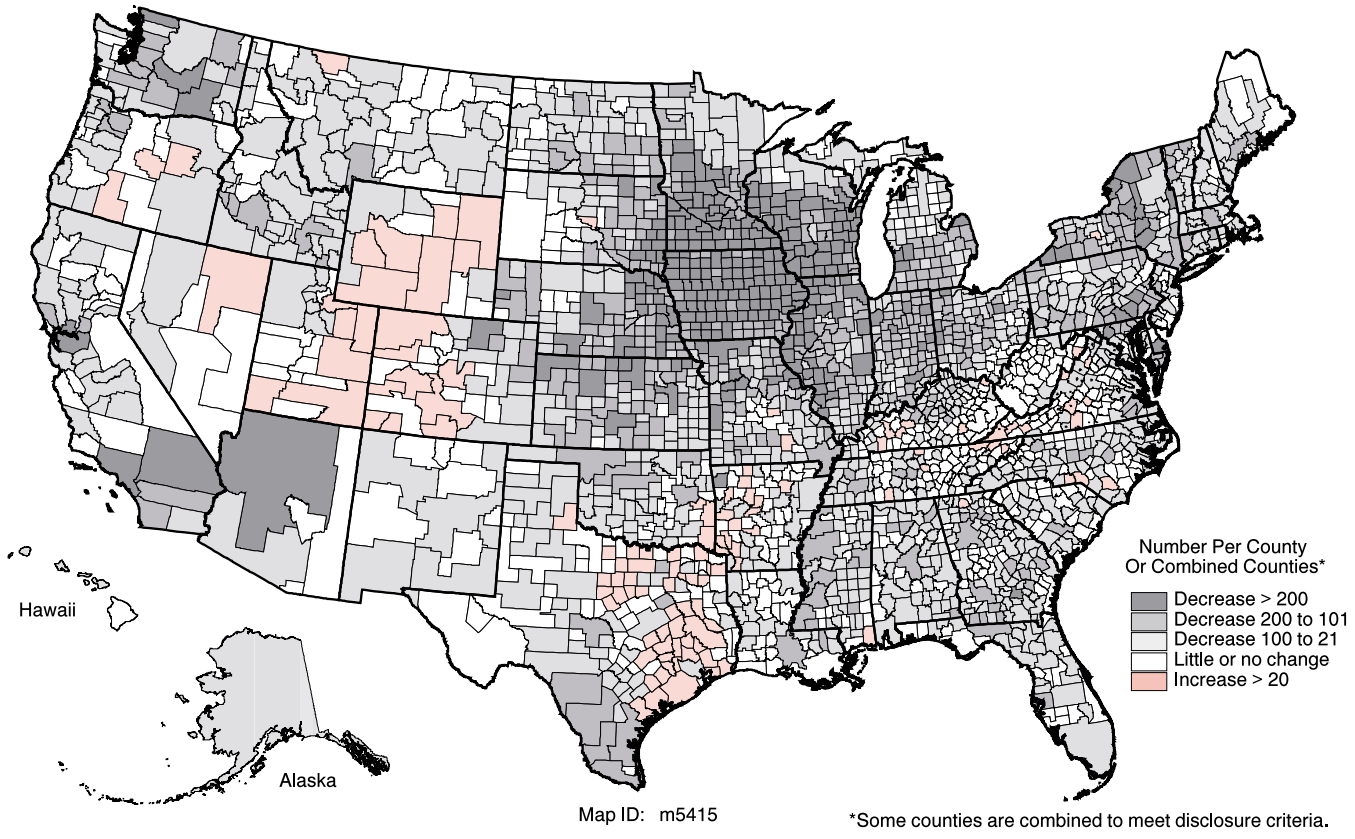
Map 2 Change in the number of livestock operations from 1982 to 1997



Map 3 Number of livestock operations with confined livestock, 1997



Map 4 Change in the number of livestock operations with confined livestock from 1982 to 1997

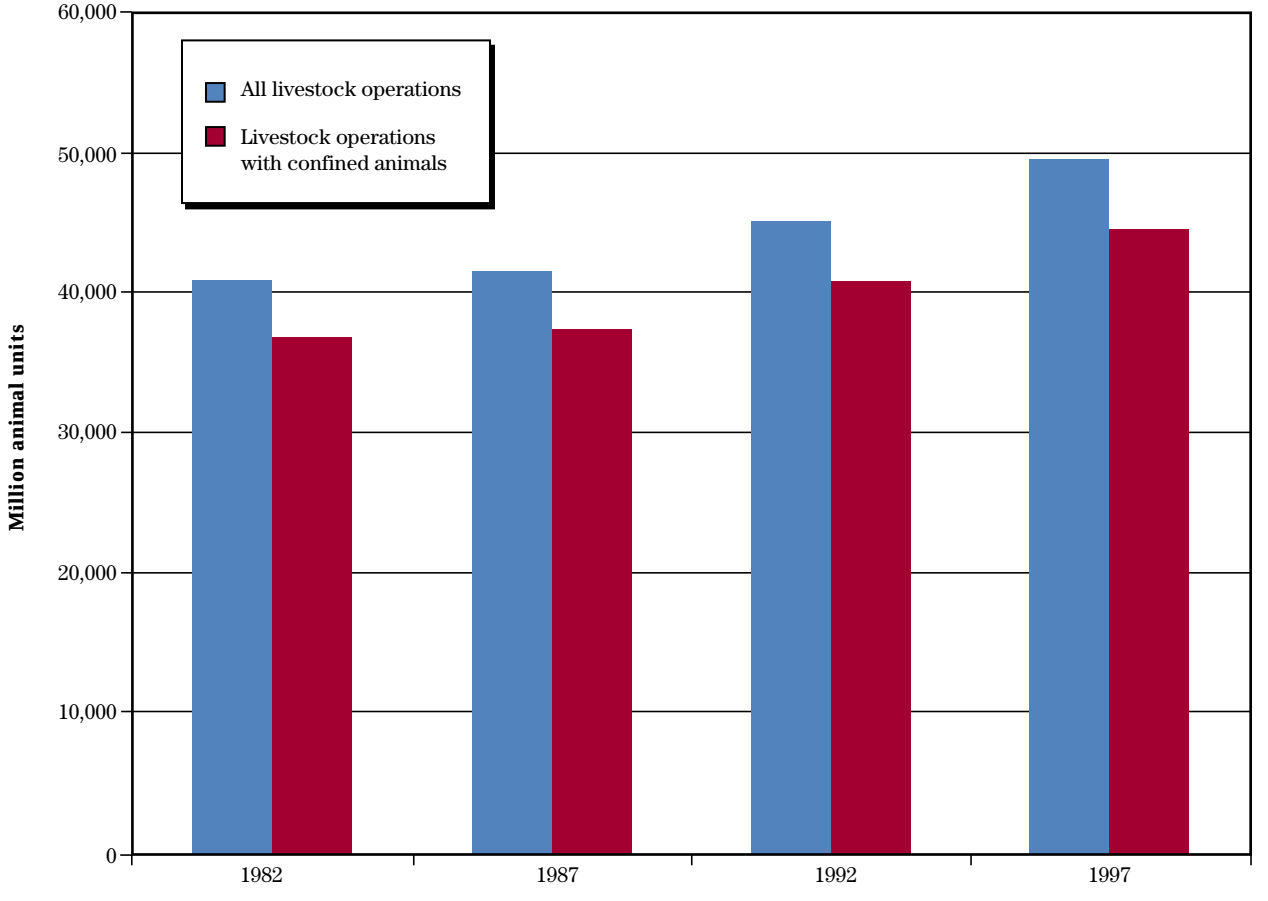


Nearly all the lost farms were small- and medium-sized operations (table 4). Between 1982 and 1992, 338,328 operations with less than 150 animal units were lost. Larger operations, on the other hand, increased substantially in number (fig. 2). Operations with 300 to 1,000 animal units increased 17 percent (20 percent for operations with confined livestock) and operations with 1,000 or more animal units increased 47 percent (58 percent for operations with confined livestock). The distribution of operations with more than 300 animal units is shown in map 5. Many counties show increasing numbers of these larger operations (map 6), but areas with the largest increases tended to be within:

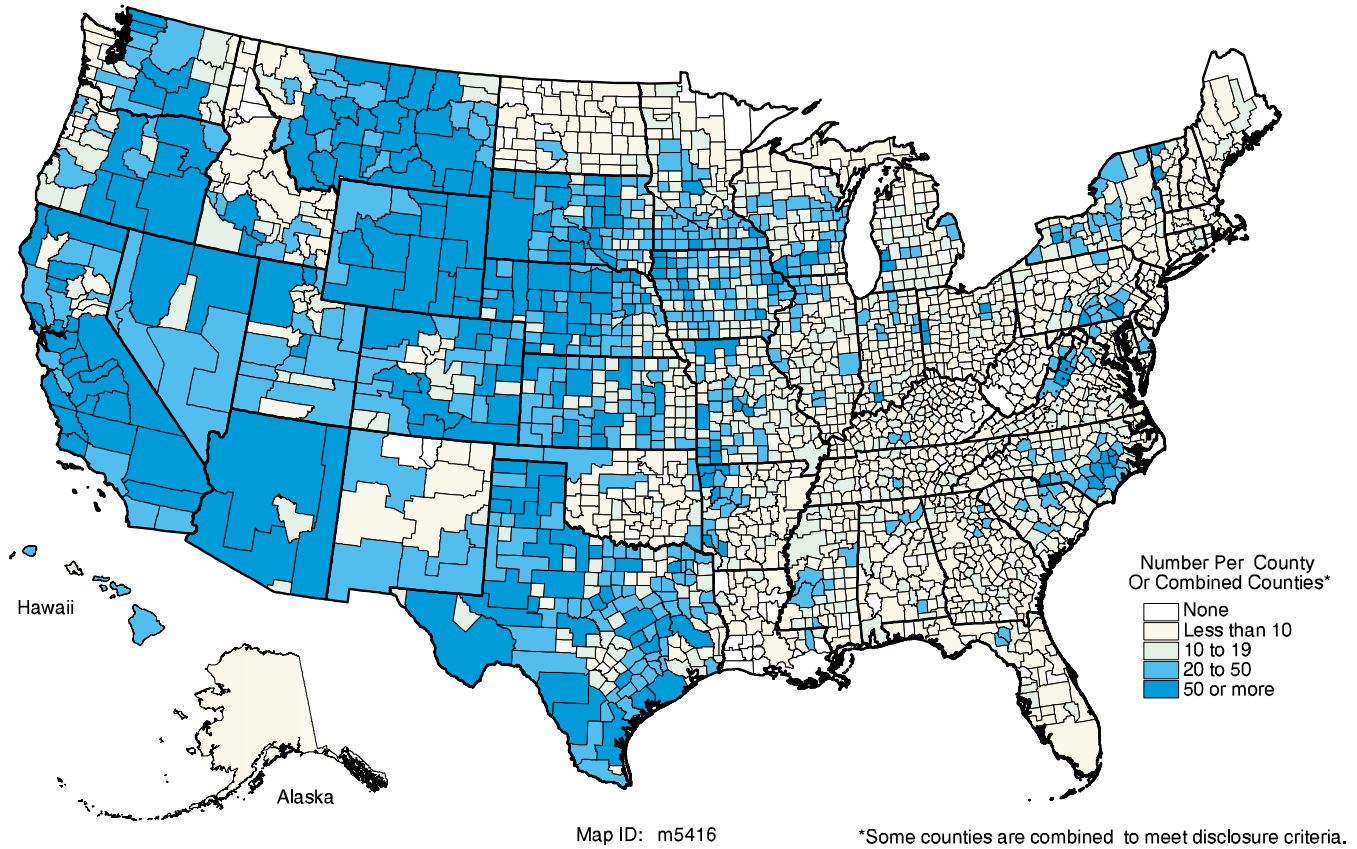
- a region of the country stretching from Wyoming and southern Montana through southern Minnesota and northern Iowa to Wisconsin,
- a region from eastern Texas north through western Arkansas to Missouri, and
- several areas in the East that are generally west of the population centers stretching from New York south to South Carolina.

Some regions—Florida and nearby states in the Southeast, states in the Southwest, and southern Iowa and northern Illinois—showed net loss of operations with more than 300 animal units, but the number of lost operations was generally small.

Figure 2 Large livestock operations (300 or more animal units per farm)



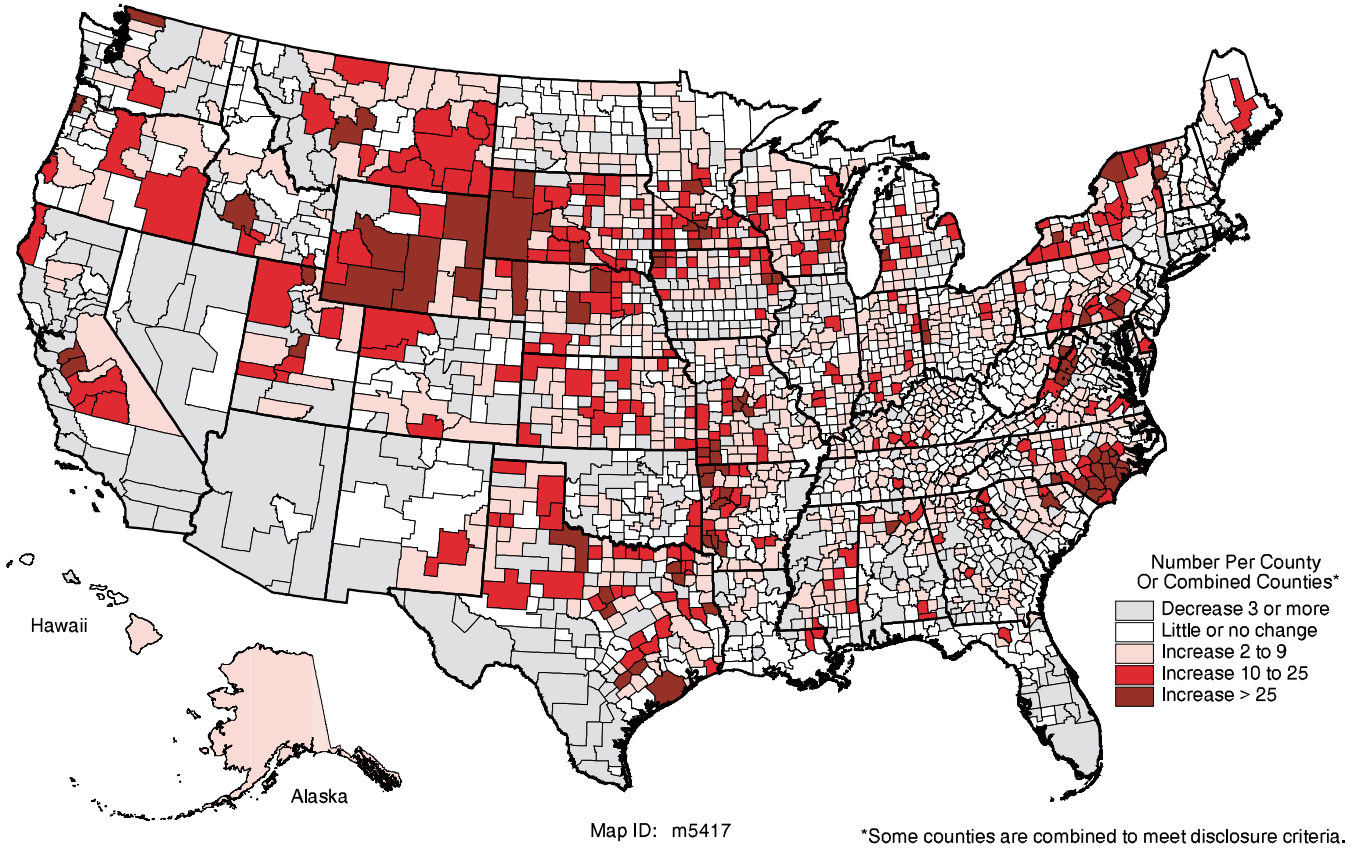
Map 5 Number of livestock operations with more than 300 animal units, 1997



Map ID: m5416

*Some counties are combined to meet disclosure criteria.

Map 6 Change in number of livestock operations with more than 300 animal units from 1982 to 1997



Map ID: m5417

*Some counties are combined to meet disclosure criteria.

In spite of the loss of nearly a fourth of the livestock operations between 1982 and 1997, the total number of animal units has remained fairly constant at about 91 to 95 million (fig. 3, table 4). In 1997, 40 percent of these were confined animal units (38 million), which was up about 7 percent from 1982. Loss of animal units on small operations was offset by increases in animal units on large operations. Animal units for confined livestock on large farms (more than 300 animal units) increased 67 percent (fig. 4). The shift in the distribution of confined livestock by farm size is shown in figure 5. Overall, the average number of confined animal units per confined livestock operation increased from 49 in 1982 to 72 in 1997, a 47.5 percent increase (table 5). When the livestock category **other beef and dairy** are excluded, the average increases 122.7 percent (from 71 to 158).

Figure 3 Animal units

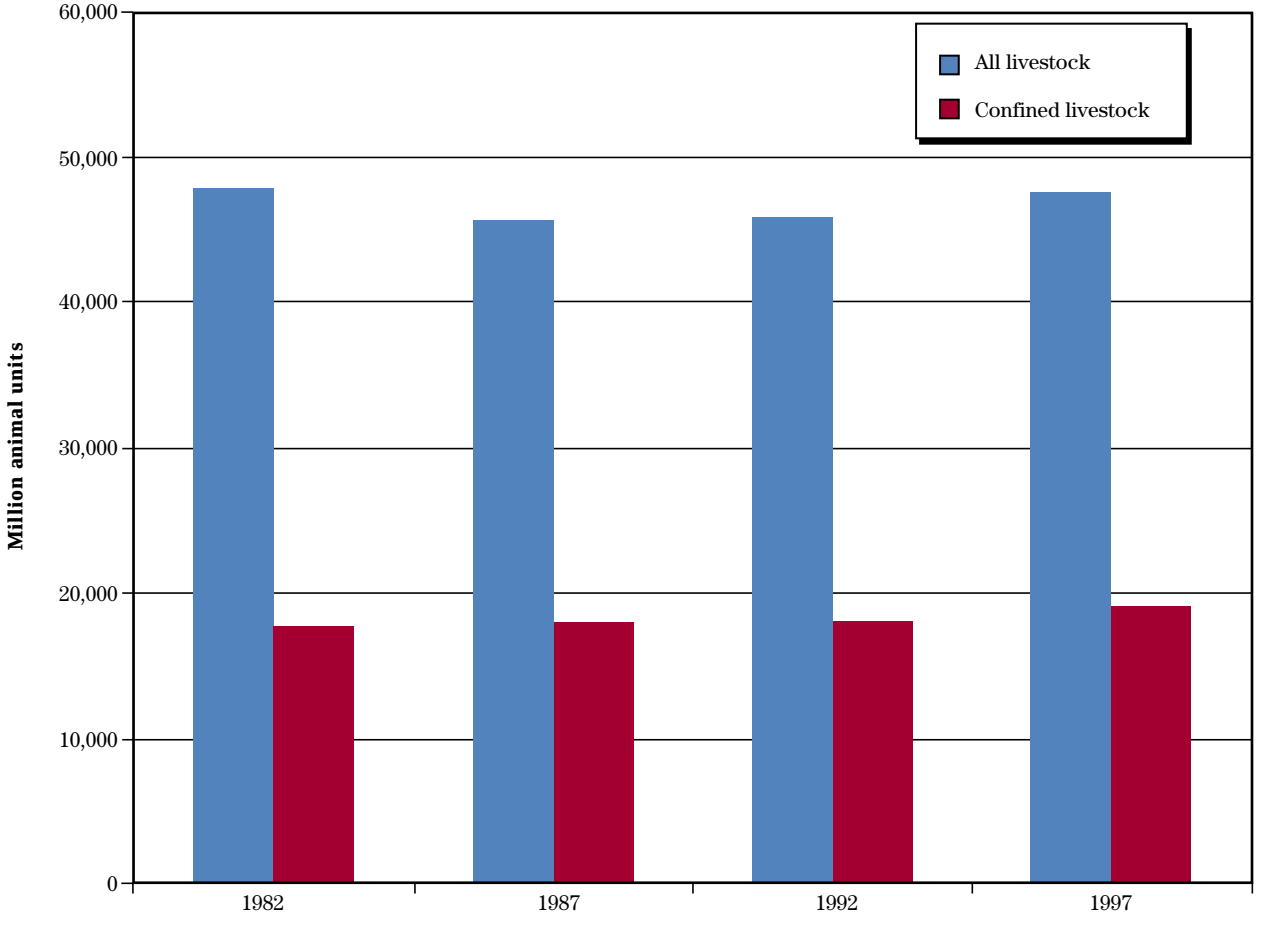


Figure 4 Animal units on large livestock operations (300 or more animal units per farm)

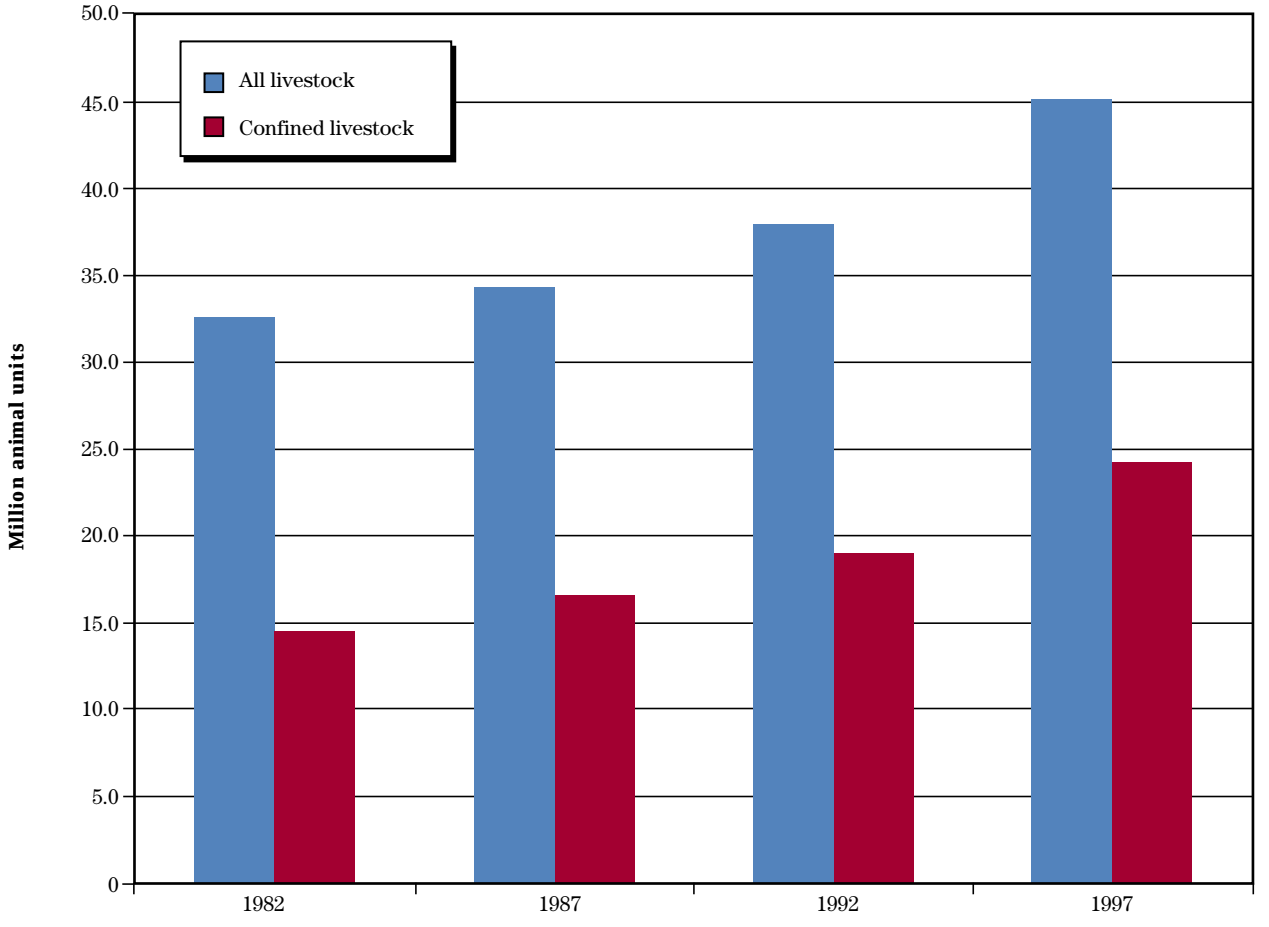
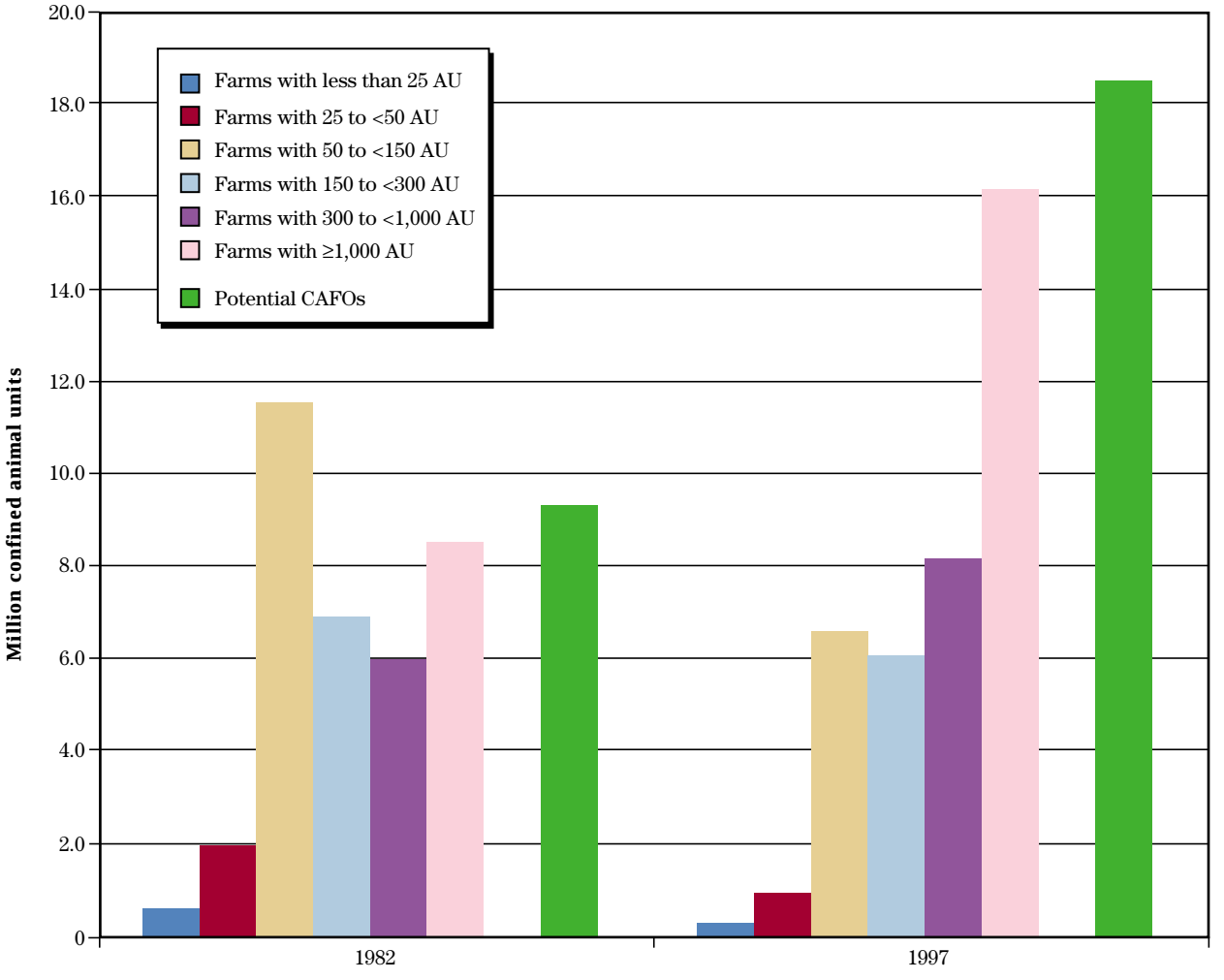


Figure 5 Confined animal units by farm size, 1982 and 1997*



* Size classes are based on total animal units on farms, including both confined livestock and livestock not held in confinement.

Table 5 Number of livestock operations and animal units by livestock type, 1982-1997*

Livestock type	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
			Number of livestock operations			
With fattened cattle	233,228	185,924	144,824	109,018	–124,210	–53
With milk cows	271,288	198,285	153,332	115,479	–155,809	–57
With other beef and dairy	1,273,529	1,122,893	1,024,952	994,236	–279,293	–22
With swine	317,087	236,945	186,021	103,965	–213,122	–67
With poultry	196,339	136,889	88,128	75,561	–120,778	–62
All livestock types**	1,385,205	1,229,341	1,114,127	1,048,731	–336,474	–24
			Number of livestock operations with confined livestock			
With fattened cattle	98,390	83,651	64,075	47,154	–51,236	–52
With milk cows	161,563	136,300	111,639	86,354	–75,209	–47
With other beef and dairy	544,090	490,557	464,597	447,381	–96,709	–18
With swine	175,284	147,052	121,219	63,723	–111,561	–64
With poultry	66,746	51,070	39,019	35,941	–30,805	–46
All livestock types**	728,539	650,665	592,710	529,658	–198,881	–27
			Number of animal units on livestock operations			
Fattened cattle	9,706,927	9,758,625	9,264,073	9,588,189	–118,738	–1
Milk cows	14,652,378	13,622,207	12,823,803	12,289,085	–2,363,293	–16
Other beef and dairy	59,897,784	55,758,084	56,662,498	58,787,447	–1,110,337	–2
Swine	7,330,637	7,201,496	7,833,189	8,522,082	1,191,445	+16
Poultry	4,032,844	4,867,275	5,353,545	6,122,411	2,089,567	+52
All livestock types**	95,620,570	91,207,687	91,937,108	95,309,215	–311,355	0
			Number of confined animal units on livestock operations			
Fattened cattle	9,107,719	9,273,561	8,897,383	9,318,175	210,456	+2
Milk cows	11,366,916	10,751,485	10,204,245	9,898,546	–1,468,370	–13
Other beef and dairy	4,692,325	4,419,122	4,454,352	4,475,087	–217,238	–5
Swine	6,300,647	6,396,356	7,206,663	8,232,837	1,932,190	+31
Poultry	4,019,413	4,858,112	5,348,144	6,118,056	2,098,643	+52
All livestock types**	35,487,021	35,698,636	36,110,787	38,042,702	2,555,681	+7
			Confined animal units per confined livestock operation			
Fattened cattle	92.6	110.9	138.9	197.6	105.0	+114
Milk cows	70.4	78.9	91.4	114.6	44.3	+63
Other beef and dairy	8.6	9.0	9.6	10.0	1.4	+16
Swine	35.9	43.5	59.5	129.2	93.3	+259
Poultry	60.2	95.1	137.1	170.2	110.0	+183
All livestock types**	48.7	54.9	60.9	71.8	23.1	+48

* A livestock operation is defined to be a farm that has more than 3 animal units or total livestock sales of more than $2,000.

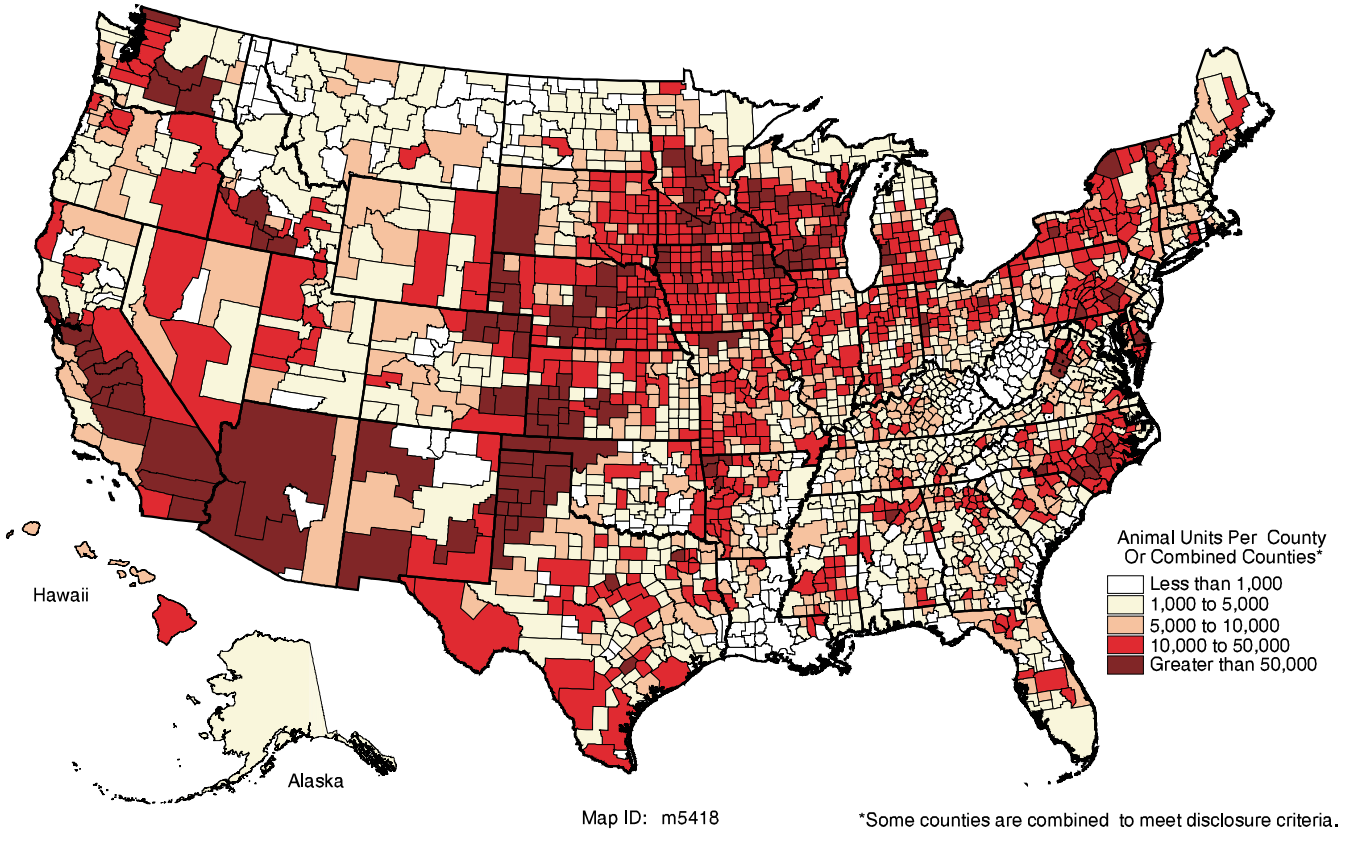
** The sum of farms over livestock types will exceed the total number of farms because many farms have more than one livestock type.

Note A breakdown of the number of livestock operations and animal units by farm size and livestock type is provided in appendix A. State estimates are provided in appendix B.

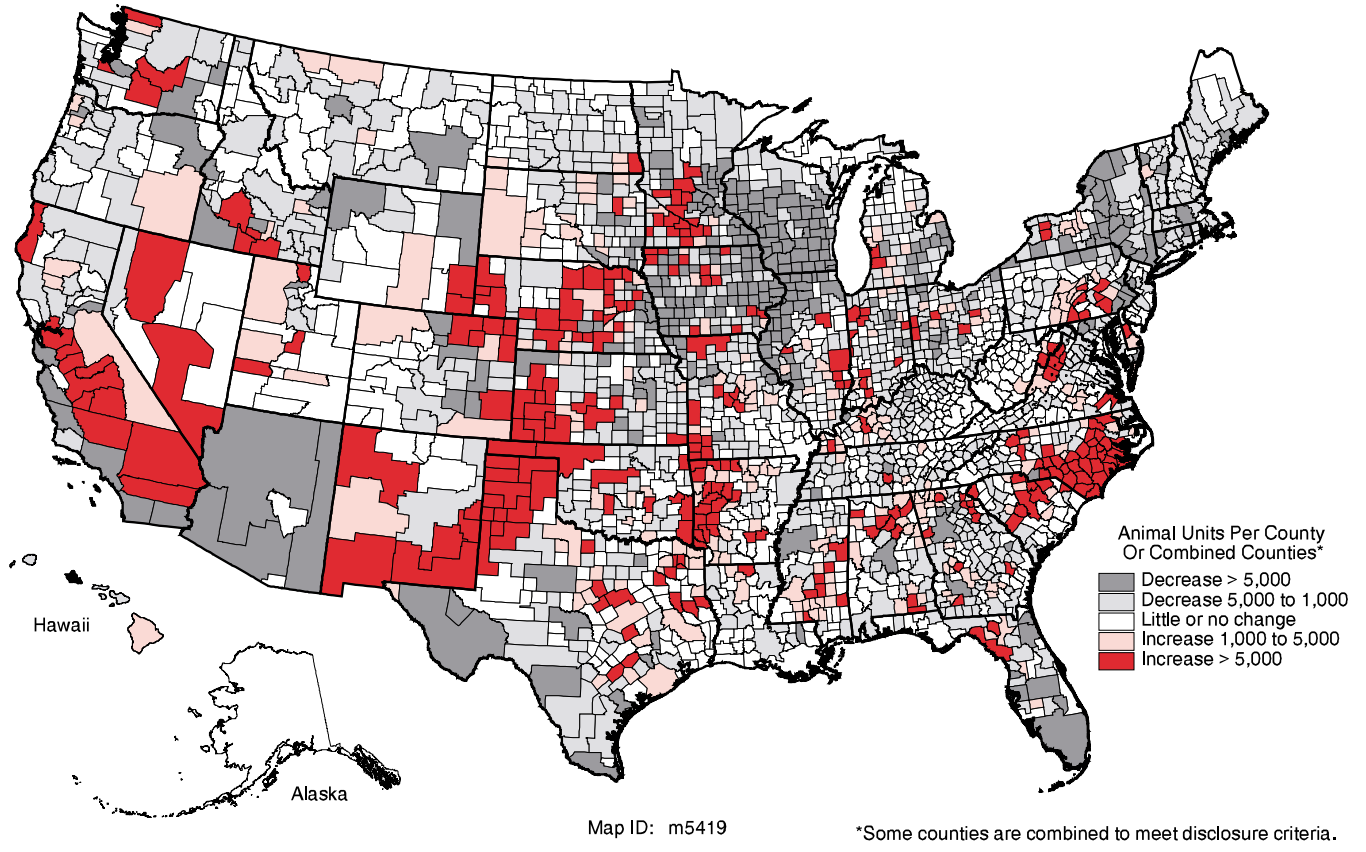
The distribution of confined animal units is shown in map 7, and the change in confined animal units between 1982 and 1997 is shown in map 8. In general, areas of the country showing large increases corresponded to areas that had high livestock populations in 1997. Some counties in Wisconsin, Michigan, Iowa, New York, southwestern Texas, and Arizona are exceptions. These counties showed decreases of more than 5,000 AU per county between 1982 and 1997, but retained significant livestock populations. Other regions showing large decreases in confined animal units include parts of states in the Northwest, the Northeast, coastal California, and Florida. Multicounty regions showing substantial increases in confined livestock animal units are North and South Carolina, the central Great Plains including New Mexico, central California, and selected counties in the Western States, southern Minnesota and northern Iowa, and a region centered around western Arkansas.

Livestock operations with confined livestock have also become more spatially concentrated. This can be seen to some extent by comparing map 7 (confined animal units for 1997) to map 9 (confined animal units for 1982). However, an analysis of the number of counties associated with a specific percentage of the total confined livestock population provides a clearer illustration of the extent to which spatial concentration has occurred. In figure 6, the cumulative number of counties (ranked from highest to lowest) is plotted against the proportion of total confined livestock associated with those counties. This graphic shows that fewer counties accounted for the bulk of confined livestock populations in 1997 than in 1982. For example, 80 percent of the confined livestock population was associated with 827 of the counties with the most livestock in 1982, compared to 667 counties in 1997.

Map 7 Animal units for confined livestock, 1997



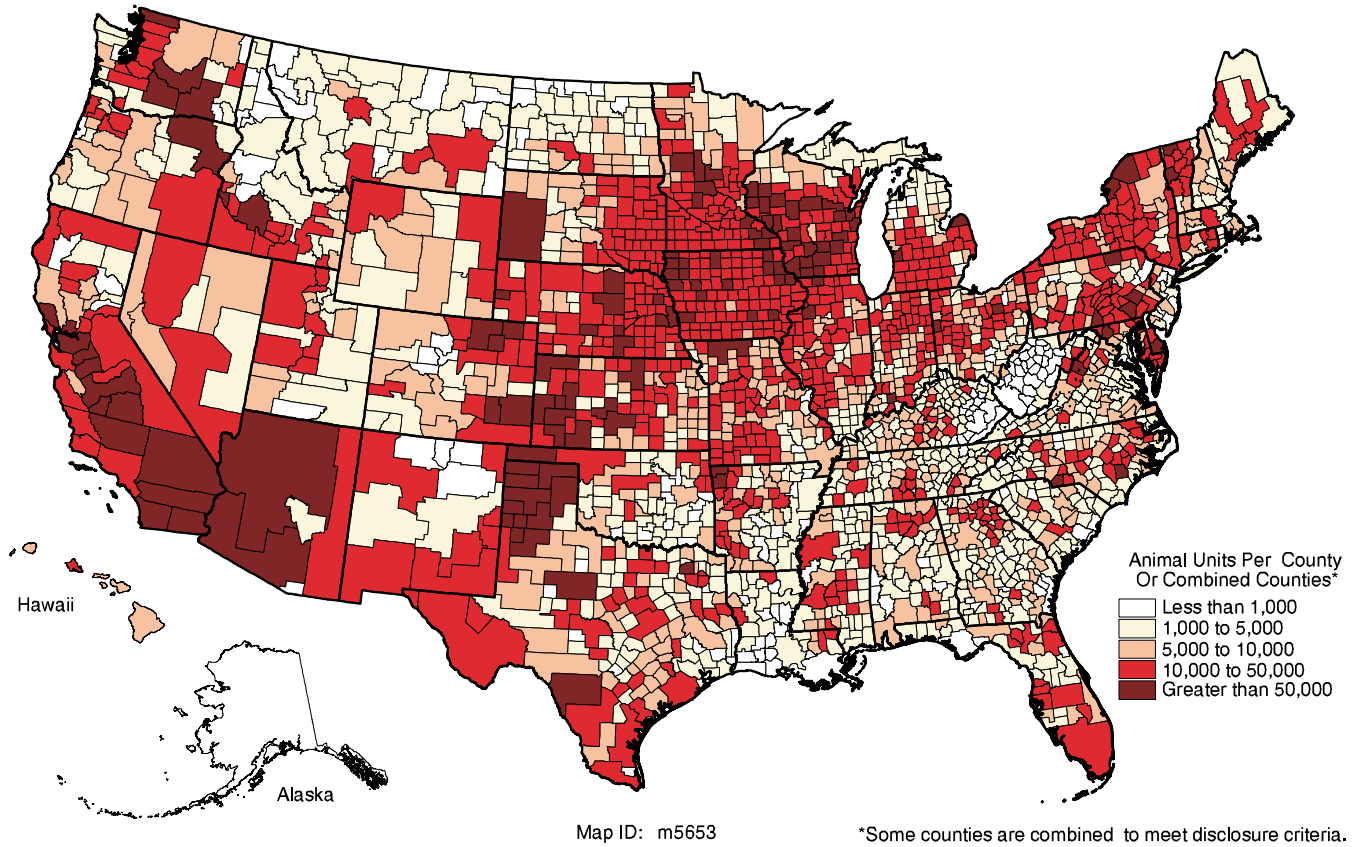
Map 8 Change in animal units for confined livestock from 1982 to 1997



Map ID: m5419

*Some counties are combined to meet disclosure criteria.

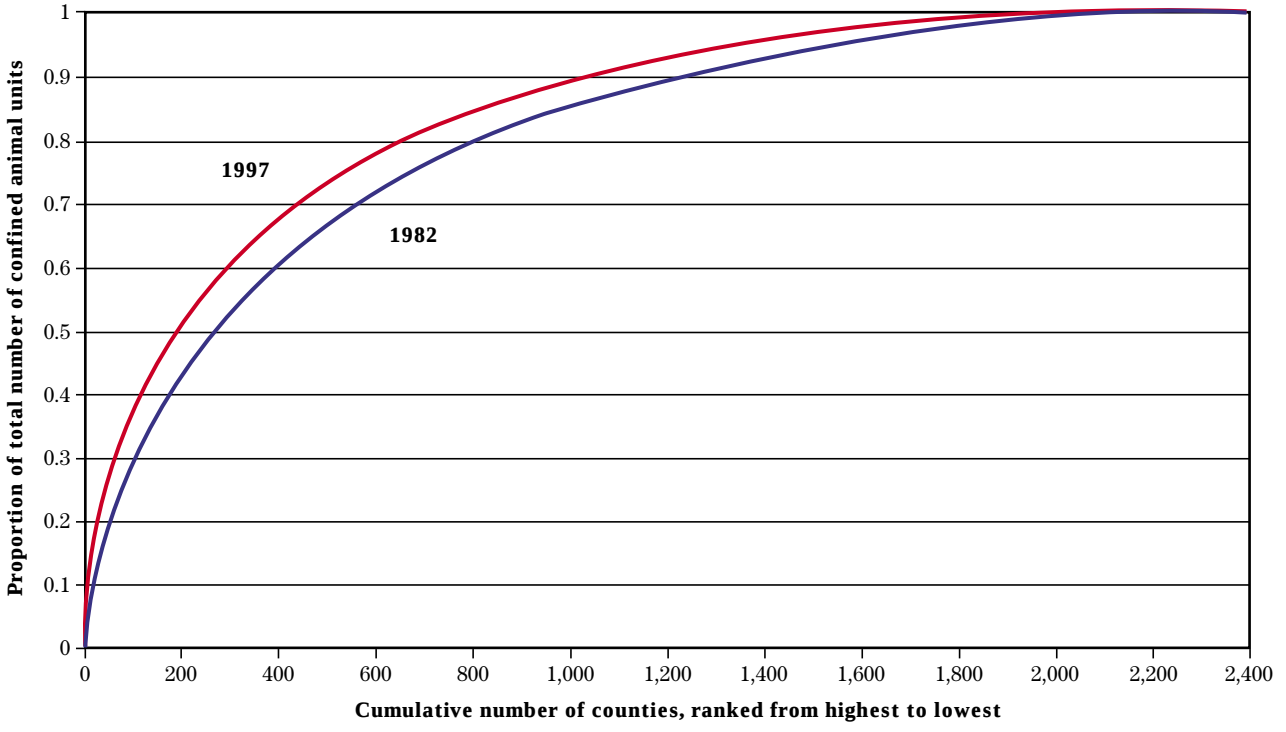
Map 9 Animal units for confined livestock, 1982



Map ID: m5653

*Some counties are combined to meet disclosure criteria.

Figure 6 Spatial concentration of confined animal units, all livestock types



Thus, 80 percent of the confined livestock occurred in 160 fewer counties in 1997 than in 1982. Spatial concentration occurred for each of the five major livestock types (figs. 7 to 11). For milk cows and other beef and dairy, decreases in the number of confined livestock (table 5) helped produce this concentration, but spatial concentration also occurred for the other three types in spite of increases in the number of confined livestock. It is especially notable that poultry exhibited increased spatial concentration, although slight, even though confined poultry populations increased 52 percent from 1982 to 1997 (table 5).

Figure 7 Spatial concentration of confined fattened cattle animal units

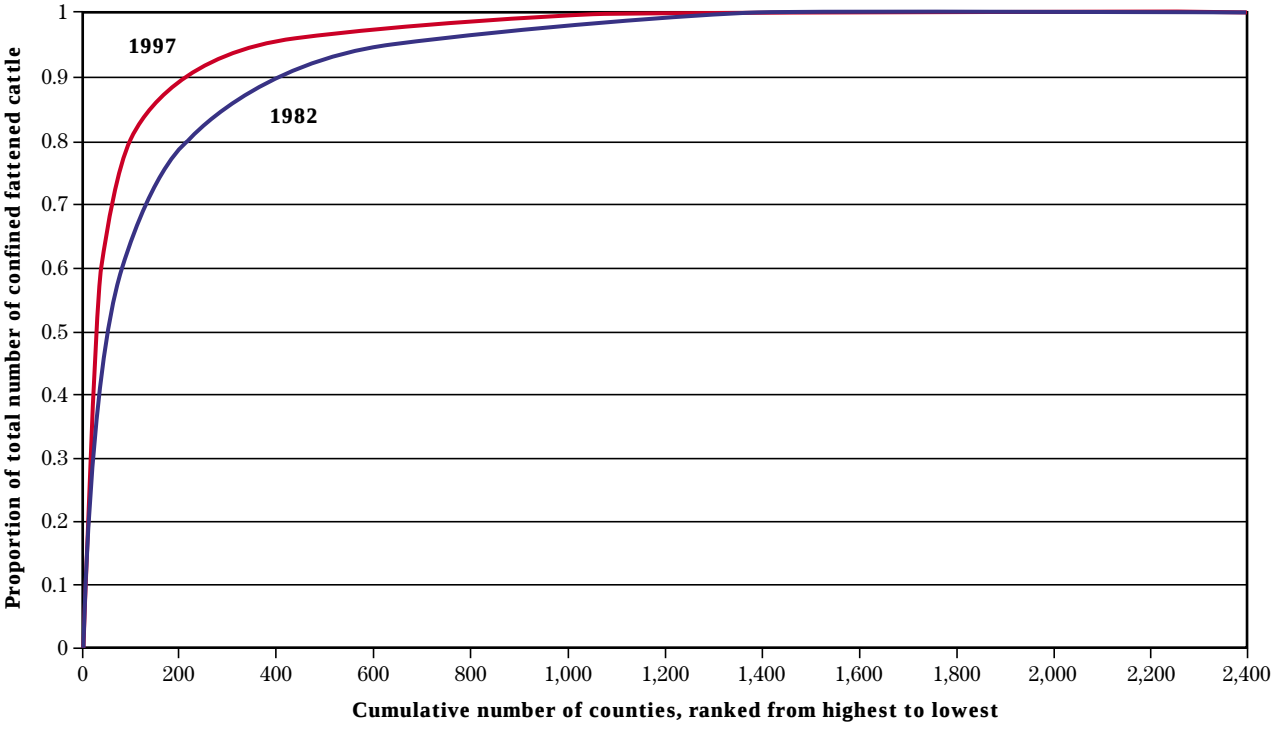


Figure 8 Spatial concentration of confined milk cow animal units

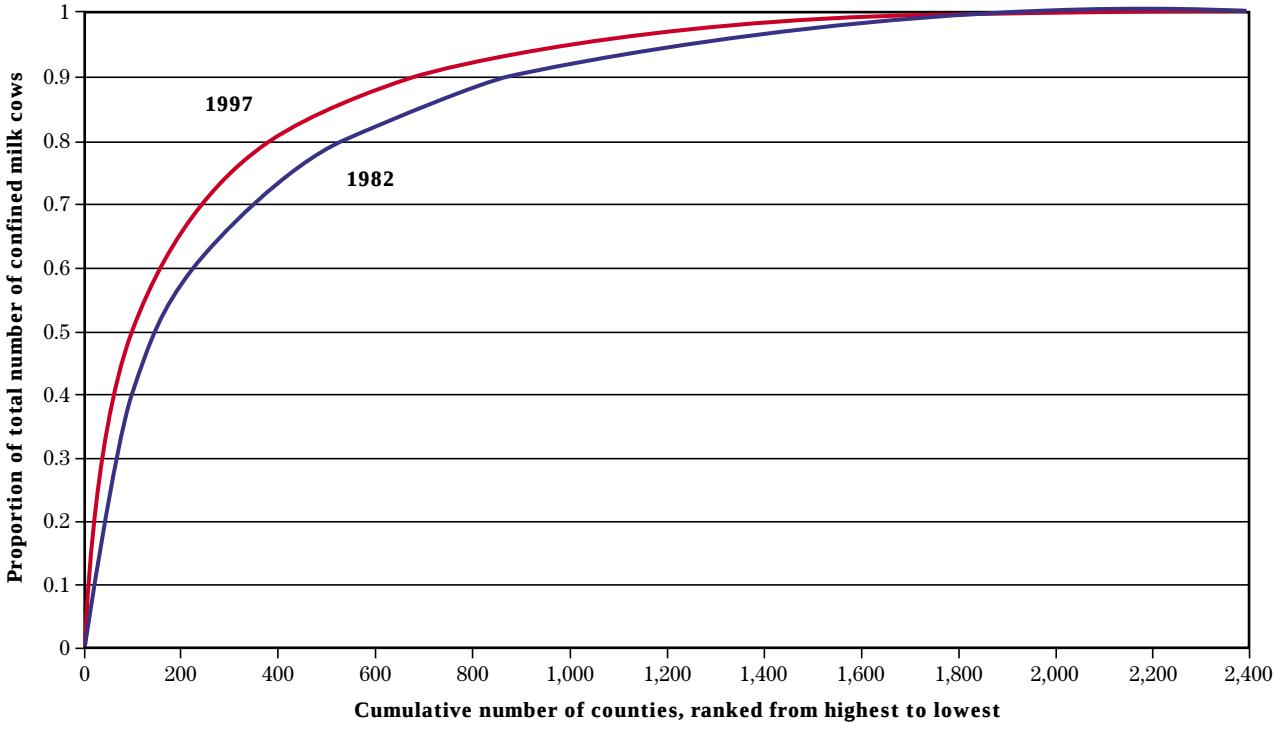


Figure 9 Spatial concentration of confined other beef and dairy cattle animal units

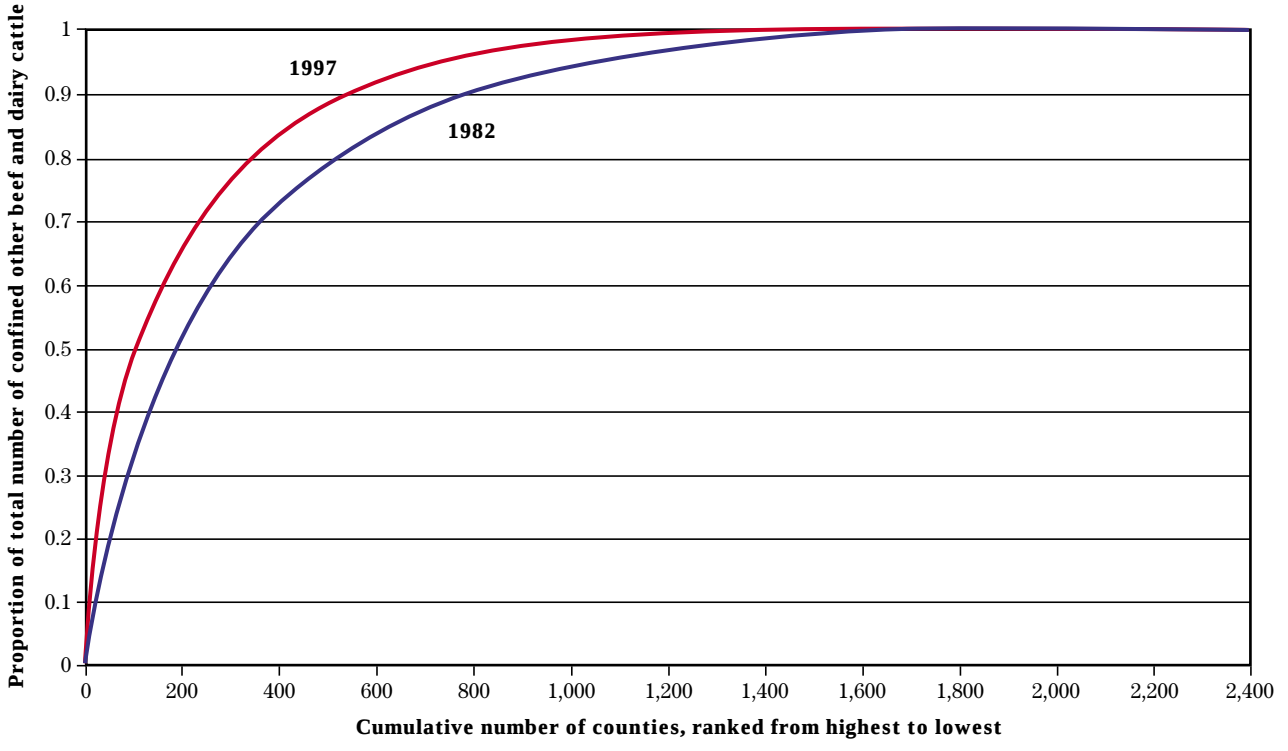


Figure 10 Spatial concentration of confined swine animal units

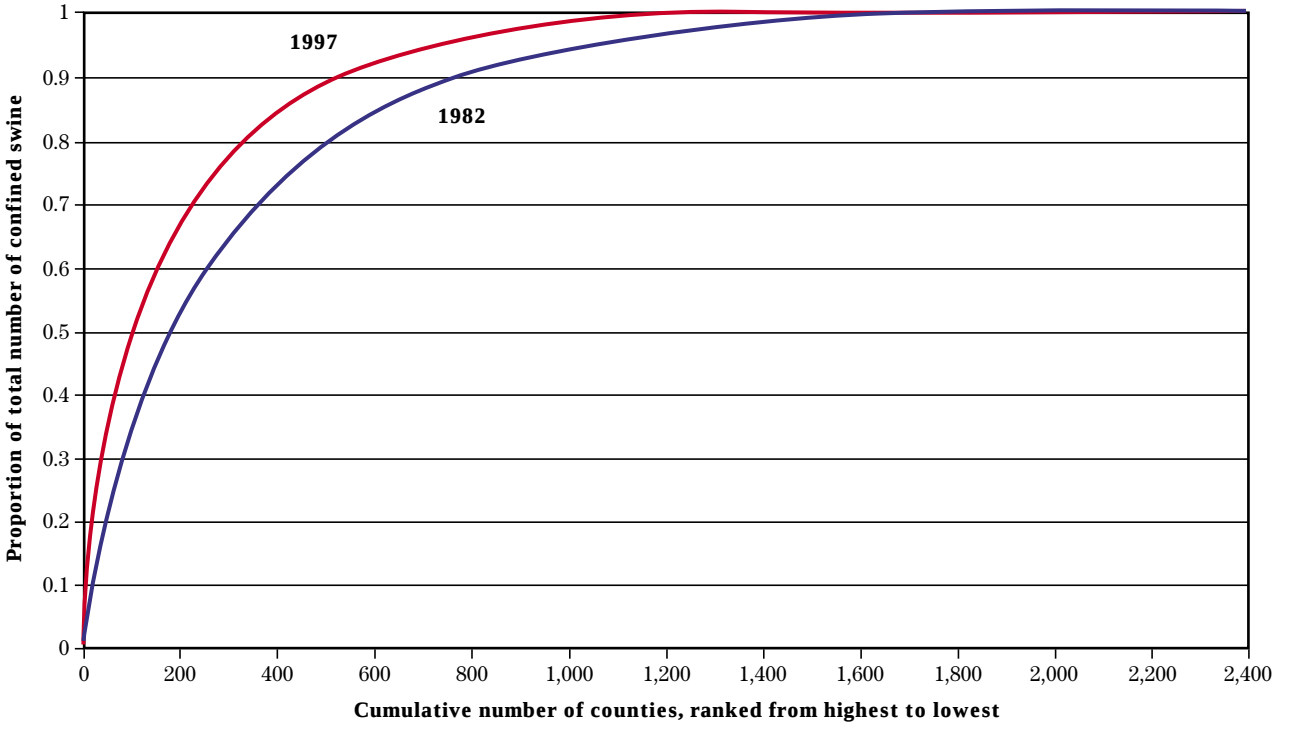
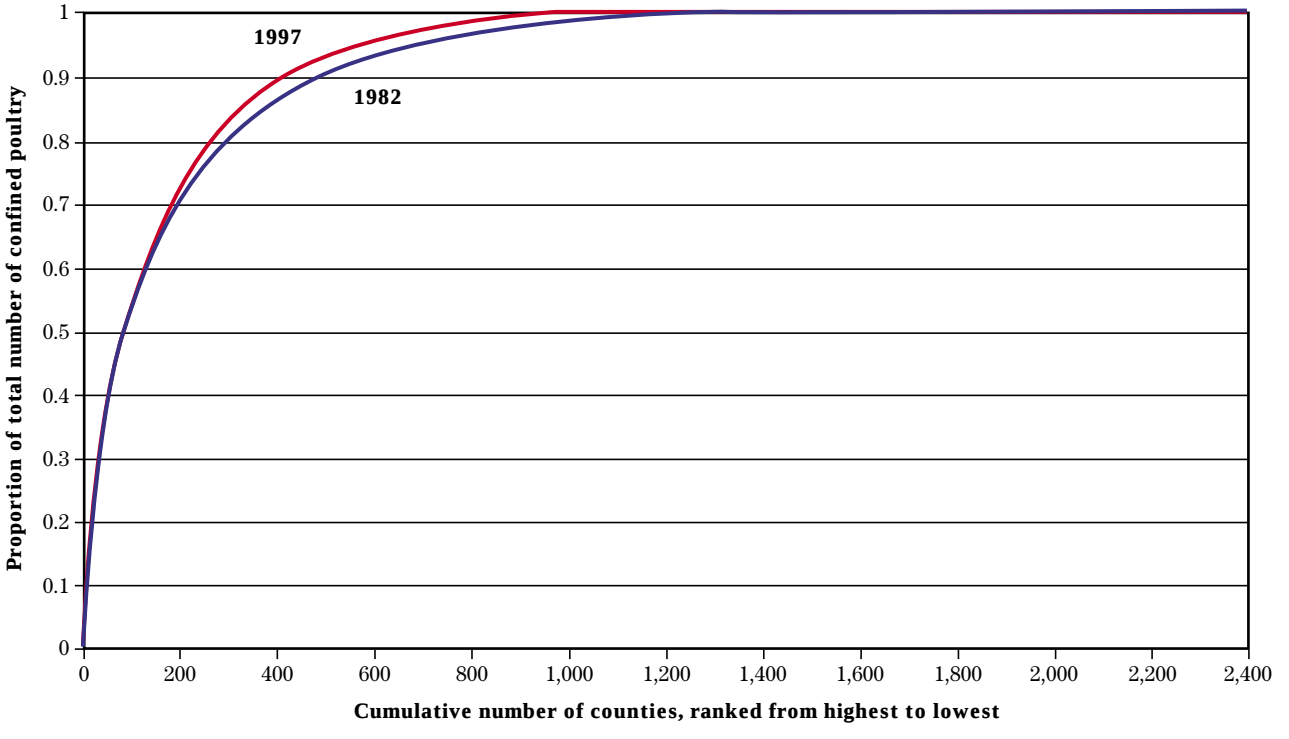


Figure 11 Spatial concentration of confined poultry animal units



By 1997, large livestock operations had increased so much in number that nearly half (48.6 percent, up from 26.2 percent in 1982) of the confined animal units in the country were on operations that potentially qualify as Concentrated Animal Feeding Operations, or CAFOs (table 6). National Pollutant Discharge Elimination System (NPDES) permits may be required by EPA for CAFOs. NPDES permits require that discharges from CAFOs be limited through appropriate storage and waste utilization systems. EPA plans to propose changes to the CAFO definition in December 2000. Proposed changes in regulations concerning CAFOs are summarized by Noel Gollehon, Margriet Caswell, Marc Ribaudo, Robert Kellogg, Charles Lander, and David Letson in *Confined Animal Production and Manure Nutrients* (forthcoming).

A livestock operation cannot be precisely identified as a CAFO using the information available in the census of agriculture. Instead, potential CAFOs were estimated based on estimates of the annual average number (head counts, not animal units) of livestock on the farm, derived from annual sales data and year-end inventories. The following rules were used to identify potential CAFOs:

- Operations with fattened cattle sales of 1,000 or more.
- Operations with milk cow end-of-year inventory of 750 or more.
- Operations with combined sow inventory and hogs on feed (average annual number based on inventory and sales) of 2,500 or more.
- Operations with an average annual number of pullets and layers (based on inventory and sales) of 100,000 or more.
- Operations with an average annual number of broilers (based on inventory and sales) of 100,000 or more
- Operations with an average annual number of turkey hens and turkeys for slaughter (based on inventory and sales) of 55,000 or more.

No attempt was made to identify CAFOs based on a mixture of these six livestock types.

The number of potential CAFOs increased from 4,963 in 1982 to 11,242 in 1997, a 127 percent increase. Even so, these operations represented only 2.1 percent of the operations with confined livestock in 1997 (table 6). The number of confined animal units on these operations doubled from about 9 million in 1982 to 18.5 million in 1997. The majority of potential CAFOs in 1997 were operations with swine (39 percent) or poultry (33 percent), followed by operations with fattened cattle (17 percent) or milk cows (11 percent). The number of potential CAFOs for fattened cattle decreased 18 percent between 1982 and 1997, whereas the number of potential CAFOs for the other three livestock types increased threefold to fourfold (187 percent for milk cows, 321 percent for swine, and 218 percent for poultry).

According to Paul Shriner of EPA's Office of Science and Technology, EPA has also estimated the number of CAFOs using the published census of agriculture, published NASS survey results for specific livestock sectors, and other information. Using only the census of agriculture data, the estimate in this study for potential fattened cattle CAFOs in 1997 is 1,897 compared to EPA's estimate (at the time of this writing) of 2,085 (including veal). For dairies, the estimate is 1,296 compared to EPA's estimate of 1,845 (including about 400 heifer operations). For swine, the estimate is 4,374 compared to EPA's estimate of 4,092. The estimate for poultry (all types) is 3,763, compared to EPA's separate estimates of 3,940 for broilers, 720 for layers and pullets, and 369 for turkeys. Differences between this study's potential CAFO estimates and the EPA preliminary estimates reflect differences in information sources, algorithms for calculating livestock populations, and assumptions about the number of cycles of production.

Table 6 Number of potential CAFOs and animal units for potential CAFOs, 1982-1997, by livestock type*

Livestock type	1982	1987	1992	1997	Percent change 1982 to 1997
All livestock types**					
Number of potential CAFOs	4,963	6,016	7,831	11,242	+127
Percent of all livestock operations	0.4%	0.5%	0.7%	1.1%	
Percent of livestock operations with confined animals	0.7%	0.9%	1.3%	2.1%	
Number of confined animal units	9,293,887	11,202,639	13,201,571	18,505,974	+99
Percent of confined animal units on all operations	26.2%	31.4%	36.6%	48.6%	
Fattened cattle					
Number of potential fattened cattle CAFOs	2,325	2,264	2,155	1,897	–18
Percent of livestock operations with fattened cattle	1.0%	1.2%	1.5%	1.7%	
Percent of livestock operations with confined fattened cattle	2.4%	2.7%	3.4%	4.0%	
Number of confined fattened cattle animal units	6,490,191	7,101,061	7,197,680	8,033,094	+24
Percent of confined fattened cattle on all operations	71.3%	76.6%	80.9%	86.2%	
Milk cows					
Number of potential dairy CAFOs	451	609	908	1,296	+187
Percent of all livestock operations with milk cows	0.2%	0.3%	0.6%	1.1%	
Percent of livestock operations with confined milk cows	0.3%	0.4%	0.8%	1.5%	
Number of confined milk cow animal units	574,346	822,504	1,311,522	2,129,633	+271
Percent of confined milk cows on all operations	5.1%	7.7%	12.9%	21.5%	
Swine					
Number of potential swine CAFOs	1,040	1,392	2,269	4,374	+321
Percent of all livestock operations with swine	0.3%	0.6%	1.2%	4.2%	
Percent of livestock operations with confined swine	0.6%	0.9%	1.9%	6.9%	
Number of confined swine animal units	693,137	1,021,373	1,895,453	4,669,717	+574
Percent of confined swine on all operations	11.0%	16.0%	26.3%	56.7%	
Poultry					
Number of potential poultry CAFOs	1,185	1,799	2,563	3,763	+218
Percent of all livestock operations with poultry	0.6%	1.3%	2.9%	5.0%	
Percent of livestock operations with confined poultry	1.8%	3.5%	6.6%	10.5%	
Number of confined poultry animal units	1,237,327	1,887,471	2,314,548	3,019,450	+144
Percent of confined poultry on all operations	30.8%	38.9%	43.3%	49.4%	

* See text for definition of potential CAFOs. Note that potential CAFOs can include operations with less than 1,000 animal units, especially for poultry and swine.

** The sum of farms over livestock types will exceed the total number of farms because a few farms (88) qualify as a potential CAFO for more than one livestock type. The sum of animal units over livestock types will be less than the total for all CAFOs because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO, including other beef and dairy.

Note Values taken from appendix A, tables A–2 and A–4.

Most confined livestock operations specialize in a single livestock type. Table 7 presents a breakdown of the confined animal units on livestock operations classified into 19 enterprise types based on the dominant livestock type on the farm. Less than 3 percent of the confined animal units on operations where fattened cattle, swine, layers and pullets, broilers, or turkeys are the dominant livestock type are livestock types other than the dominant type. For these enterprise types, this percentage falls to 1 percent or less for operations where the dominant livestock type comprises more than 75 percent of the animal units on the farm. However, operations where milk cows are dominant also have a significant percentage of confined other beef and dairy, and operations where other beef and dairy are dominant have a significant percentage of confined fattened cattle, milk cows, and swine. Livestock operations with a mix of confined animal types and no dominant type comprised only 1 percent of the confined livestock operations and accounted for less than 2 percent of confined livestock.

Table 7 Profile of livestock operations with confined animal units according to farm enterprise type, 1997

Enterprise type based on dominant animal type	Livestock operations		Number of confined animal units, all types	Percent of all confined animal units				
	number	percent of total		fattened cattle	milk cows	other beef and dairy	swine	poultry
Fattened cattle dominant								
>50% of total AU	13,269	2.5	8,553,722	97.9	0.0	1.6	0.5	0.0
50-75% of total AU	9,505	1.8	1,493,585	93.5	0.2	3.8	2.5	0.1
>75% of total AU	3,764	0.7	7,060,137	98.8	0.0	1.1	0.1	0.0
Milk cows dominant								
>50% of total AU	80,064	15.1	11,150,441	0.4	84.3	15.0	0.2	0.1
50-75% of total AU	54,091	10.2	7,050,411	0.6	80.6	18.3	0.3	0.1
>75% of total AU	25,973	4.9	4,100,030	0.1	90.6	9.3	0.0	0.0
Other beef and dairy dominant								
>50% of total AU	359,349	67.8	4,012,979	17.4	6.9	63.5	8.6	3.7
50-75% of total AU	21,299	4.0	1,234,130	32.3	20.2	15.6	21.5	10.4
>75% of total AU	338,050	63.8	2,778,849	10.7	1.0	84.8	2.8	0.7
Swine dominant**								
>50% of total AU	44,365	8.4	7,722,752	0.8	0.2	0.4	97.7	0.9
50-75% of total AU	7,268	1.4	756,455	6.3	2.0	3.0	81.8	6.9
>75% of total AU	37,097	7.0	6,966,297	0.2	0.0	0.1	99.5	0.2
Grow-finish farms	13,607	2.6	2,382,356	0.2	0.0	0.1	99.2	0.5
Farrowing farms	245	0.0	23,652	0.0	0.0	0.1	99.9	0.0
Farrow-finish farms	23,245	4.4	4,560,289	0.2	0.0	0.1	99.6	0.1
Layers and pullets dominant***								
>50% of total AU	6,605	1.2	1,442,956	0.2	0.4	0.3	0.8	98.3
50-75% of total AU	1,229	0.2	151,709	1.6	2.7	1.9	5.7	88.1
>75% of total AU	5,376	1.0	1,291,247	0.1	0.1	0.1	0.2	99.5
Pullets only	1,082	0.2	128,513	0.2	0.0	0.1	0.3	99.4
Layers only	3,857	0.7	683,548	0.1	0.3	0.1	0.2	99.3
Pullets and layers mixed	437	0.1	479,186	0.0	0.0	0.0	0.1	99.9

Table 7 Profile of livestock operations with confined animal units according to farm enterprise type, 1997—Continued

Enterprise type based on dominant animal type	Livestock operations		Number of confined animal units, all types	Percent of all confined animal units				
	number	percent of total		fattened cattle	milk cows	other beef and dairy	swine	poultry
Broilers dominant								
>50% of total AU	16,754	3.2	2,393,000	0.1	0.1	0.6	0.2	99.0
50-75% of total AU	3,285	0.6	420,156	0.3	0.7	2.5	0.8	95.7
>75% of total AU	13,469	2.5	1,972,844	0.0	0.0	0.2	0.1	99.8
Turkeys dominant								
>50% of total AU	3,329	0.6	2,085,482	0.1	0.3	0.3	1.5	97.9
50-75% of total AU	332	0.1	157,862	0.6	2.5	1.7	16.7	78.5
>75% of total AU	2,997	0.6	1,927,620	0.0	0.1	0.2	0.2	99.5
Mixed, no dominant type	5,923	1.1	681,375	19.8	27.6	10.1	33.8	8.8
Total	529,658	100.0	38,042,707	24.5	26.0	11.8	21.6	16.1

* A livestock operation is defined to be a farm that has more than 3 animal units or total livestock sales of more than $2,000.

** Grow-finish farms are farms where hogs for slaughter are 95 percent or more of the swine animal units on the farm. Farrowing farms are farms where hogs for breeding are 95 percent or more of the swine animal units on the farm. Farrow-finish farms are the remaining farms that have a mix of hogs for slaughter and breeding hogs that together comprise at least 75 percent of the animal units on the farm.

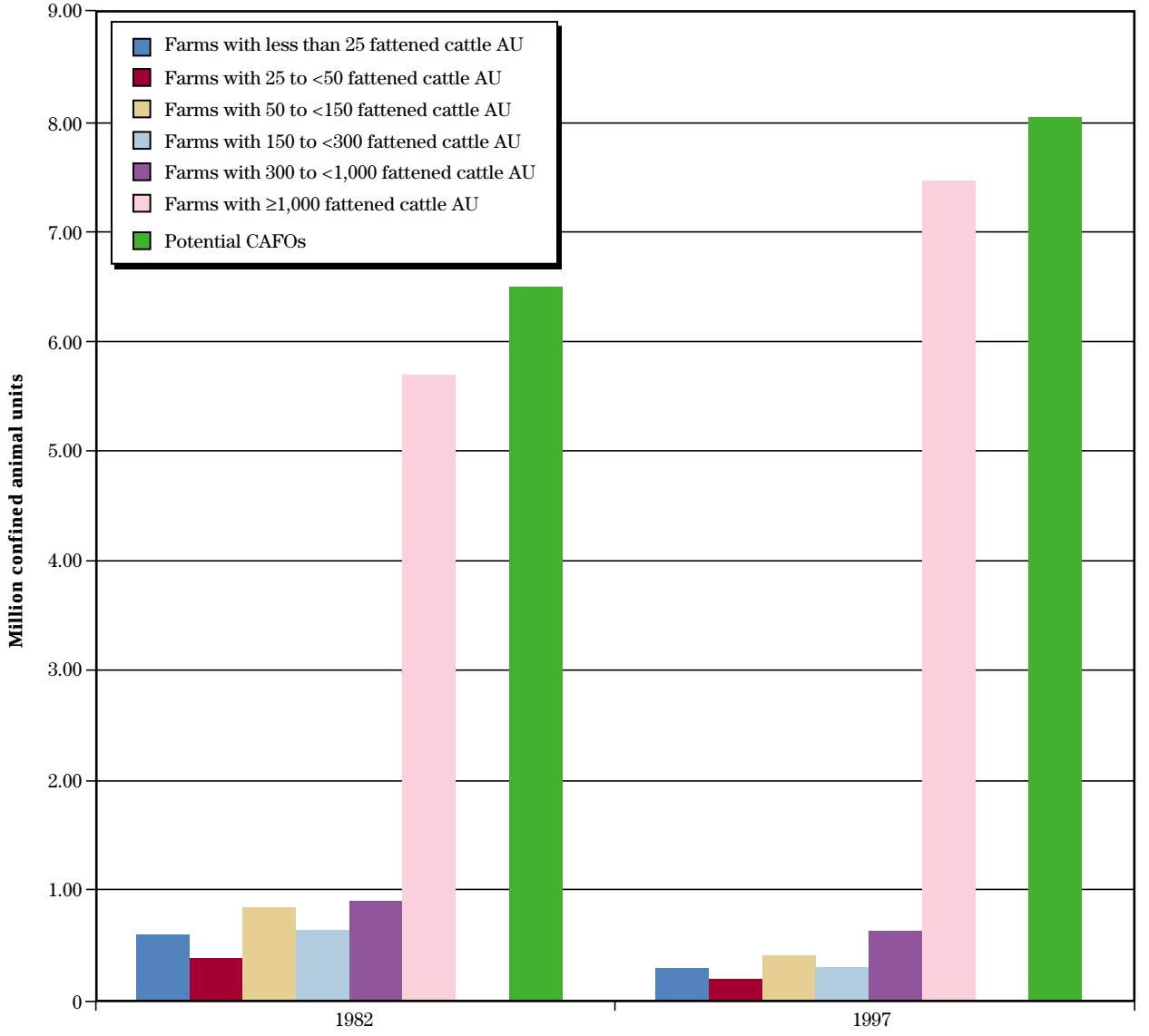
*** *Pullet only* farms are farms where pullets are 95 percent or more of the pullet and layer animal units on the farm. *Layer only* farms are farms where layers are 95 percent or more of the pullet and layer animal units on the farm. *Pullet and layer mixed* farms are the remaining farms that have a mix of layers and pullets that together comprise at least 75 percent of the animal units on the farm.

Notes: A breakdown of the number of livestock operations and animal units by farm capacity is provided in appendix C.
Each farm is uniquely assigned to one of 19 enterprise types based on the dominant animal type on the farm. Both confined livestock and livestock not held in confinement were used to derive the dominant animal type. Three categories of dominant farms were derived:

- farms where the dominant type comprises at least 50 percent of the animal units on the farm,
- farms where the dominant type comprises at least 75 percent of the animal units on the farm, and
- farms where the dominant type comprises 50 to 75 percent of the animal units on the farm.

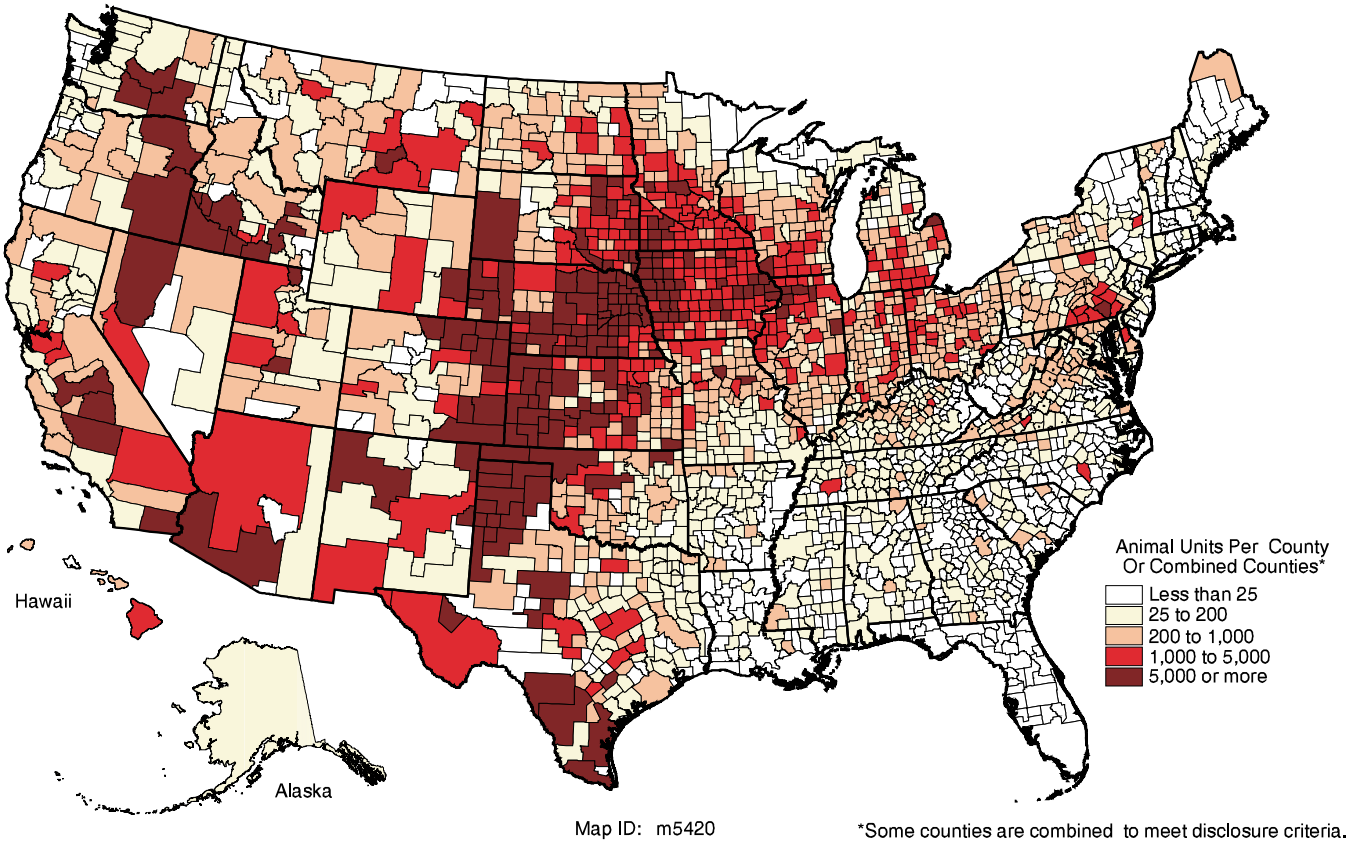
Fattened cattle animal units remained fairly constant over the four Census years from 1982 to 1997 at about 9.5 to 9.7 million, nearly all of which were confined (table 5). At the same time, however, the number of fattened cattle operations decreased by over 50 percent. All size classes showed substantial loss of operations (appendix A, tables A–1 and A–2) except for the largest size class, which showed almost no change in the number of operations. The vast majority of fattened cattle (about 80 percent) were on the largest operations (1,000 or more animal units). These large operations had a 31 percent increase in animal units from 1982 to 1997. The change in the distribution of confined fattened cattle by farm size is shown in figure 12. Few confined fattened cattle are raised in the Southeast or the Northeast (map 10). The largest increases in confined fattened cattle animal units between 1982 and 1997 occurred in the central Great Plains and a few counties in the West (map 11). Most other areas had decreases.

Figure 12 Confined fattened cattle animal units by farm size, 1982 and 1997*



* Size classes are based on total fattened cattle on farms, including both confined fattened cattle and fattened cattle not held in confinement.

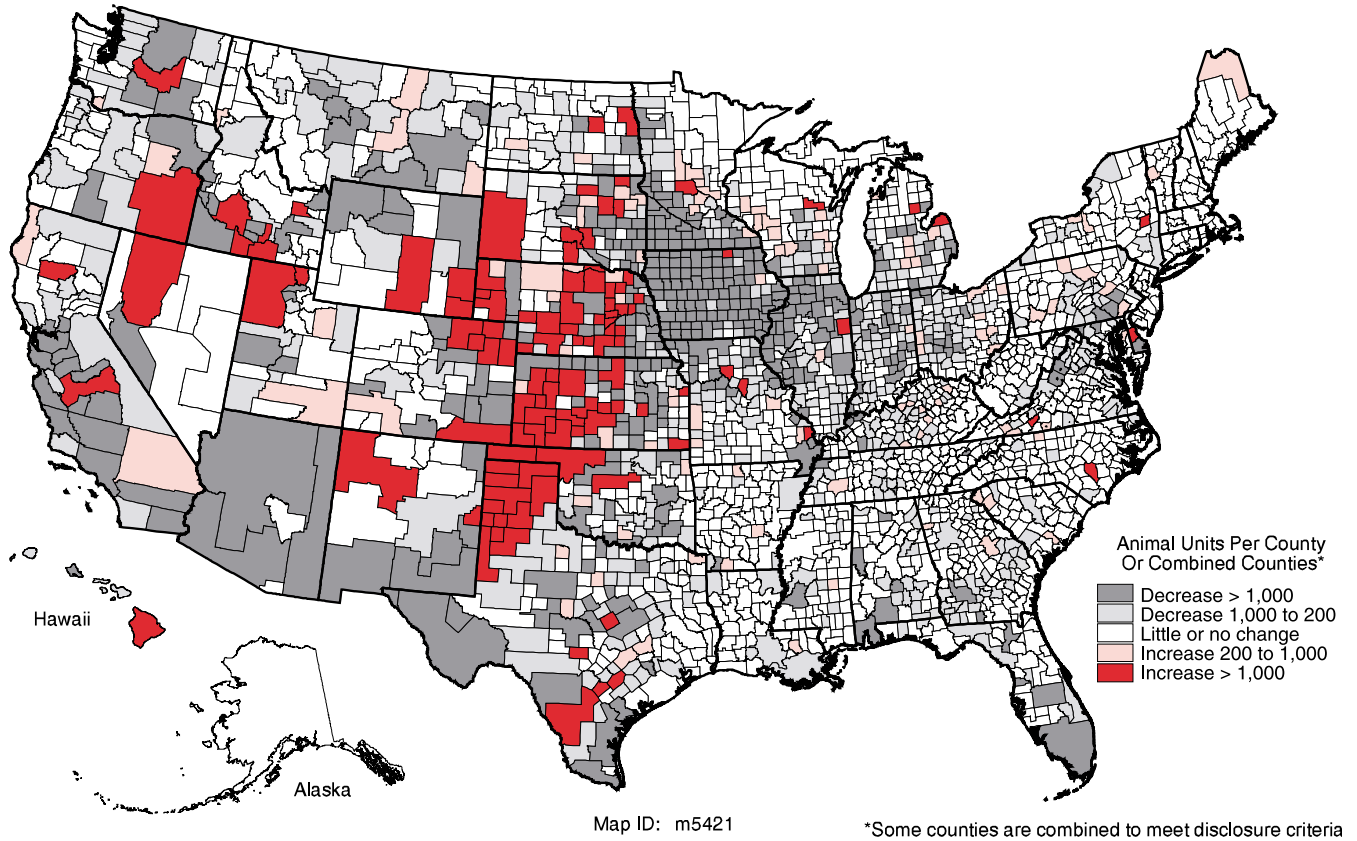
Map 10 Animal units for confined fattened cattle, 1997



Map ID: m5420

*Some counties are combined to meet disclosure criteria.

Map 11 Change in animal units for confined fattened cattle from 1982 to 1997

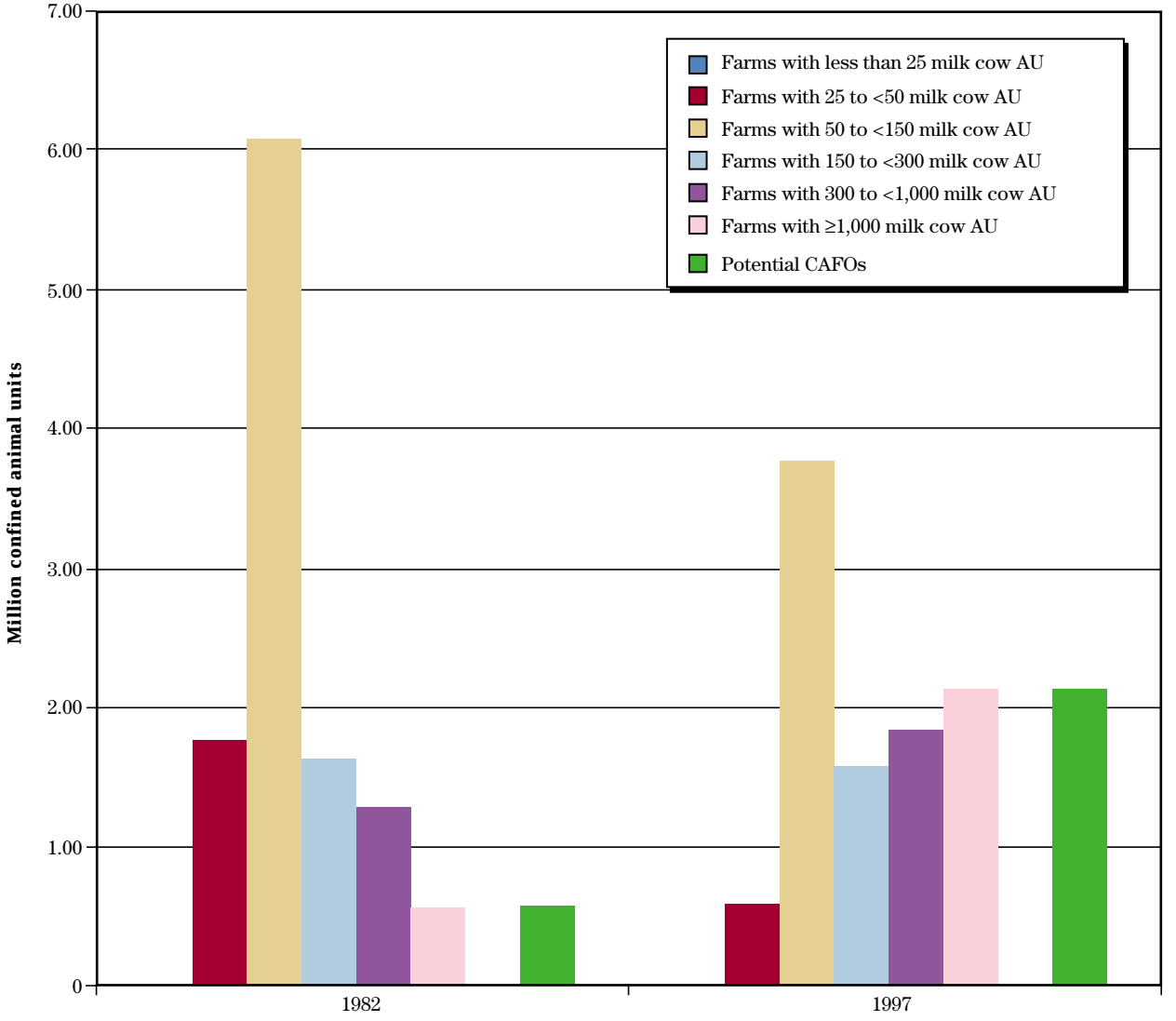


Map ID: m5421

*Some counties are combined to meet disclosure criteria

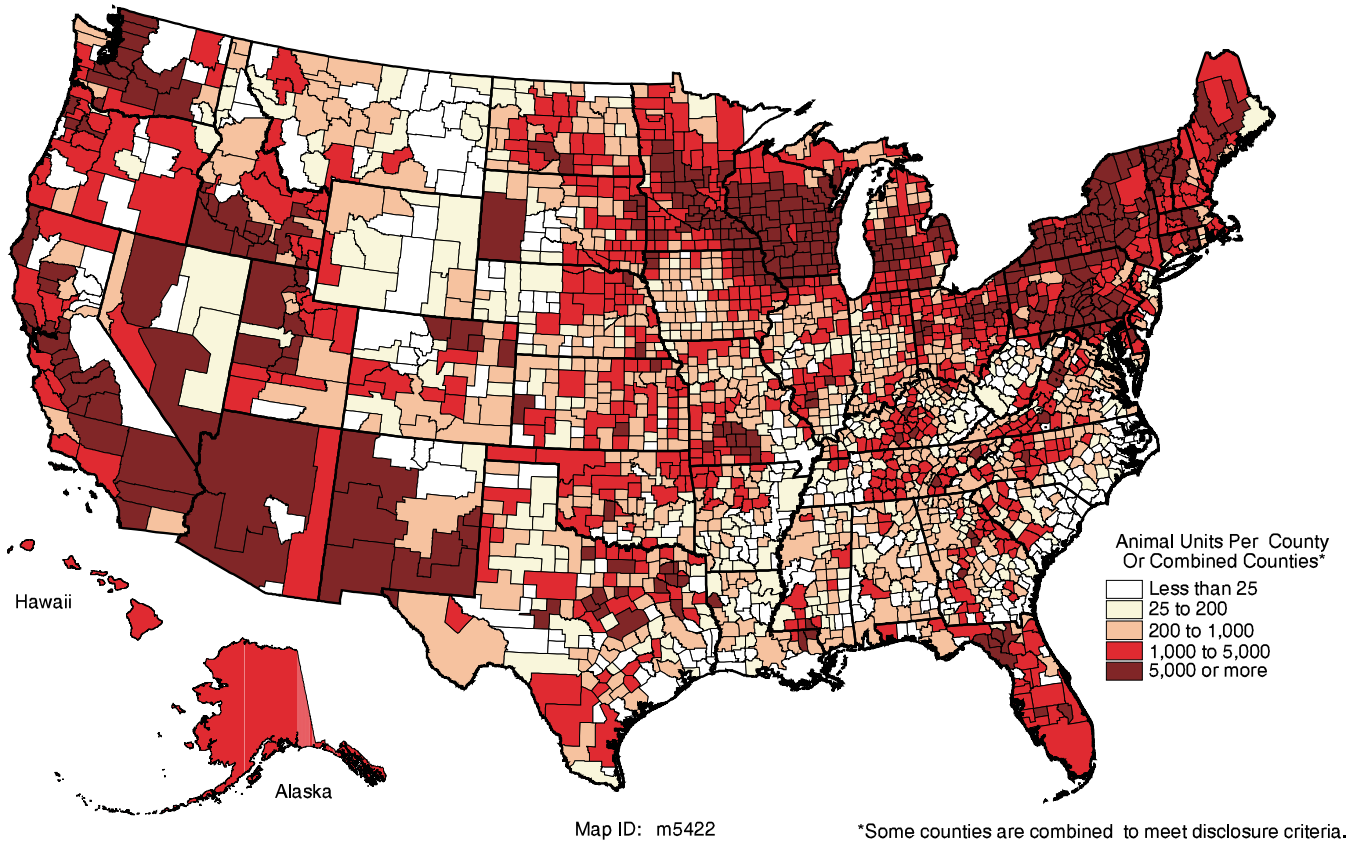
The only major livestock type to show substantial decreases in animal units was milk cows. Milk cow animal units fell from 14.6 million in 1982 to 12.3 million in 1997, a 16 percent decrease (13 percent decrease for confined milk cows) (table 5). This decrease was largely the result of the loss of small dairies. Livestock operations with less than 50 milk cow animal units fell 71 percent, and operations with 50 to 150 animal units fell 42 percent (appendix A, table A–1). In 1982, the majority of confined milk cows were on operations with less than 150 milk cow animal units. By 1997, however, over half of the confined milk cows were on operations with 300 or more milk cow animal units (fig. 13). The number of operations with 1,000 or more milk cows nearly tripled, increasing from 456 in 1982 to 1,303 in 1997. The number of confined milk cow animal units on these large operations increased by about 1.5 million (271 percent) (appendix A, table A–4). Dairies are in most areas of the country, but are concentrated in Northeast States, North Central States, Florida, and the West (map 12). Increases in confined milk cow animal units occurred generally in the West, and large decreases in confined milk cow animal units occurred throughout the North Central States and the Northeast (map 13).

Figure 13 Confined milk cow animal units by farm size, 1982 and 1997*



* Size classes are based on total milk cows on farms, including both confined milk cows and milk cows not held in confinement.

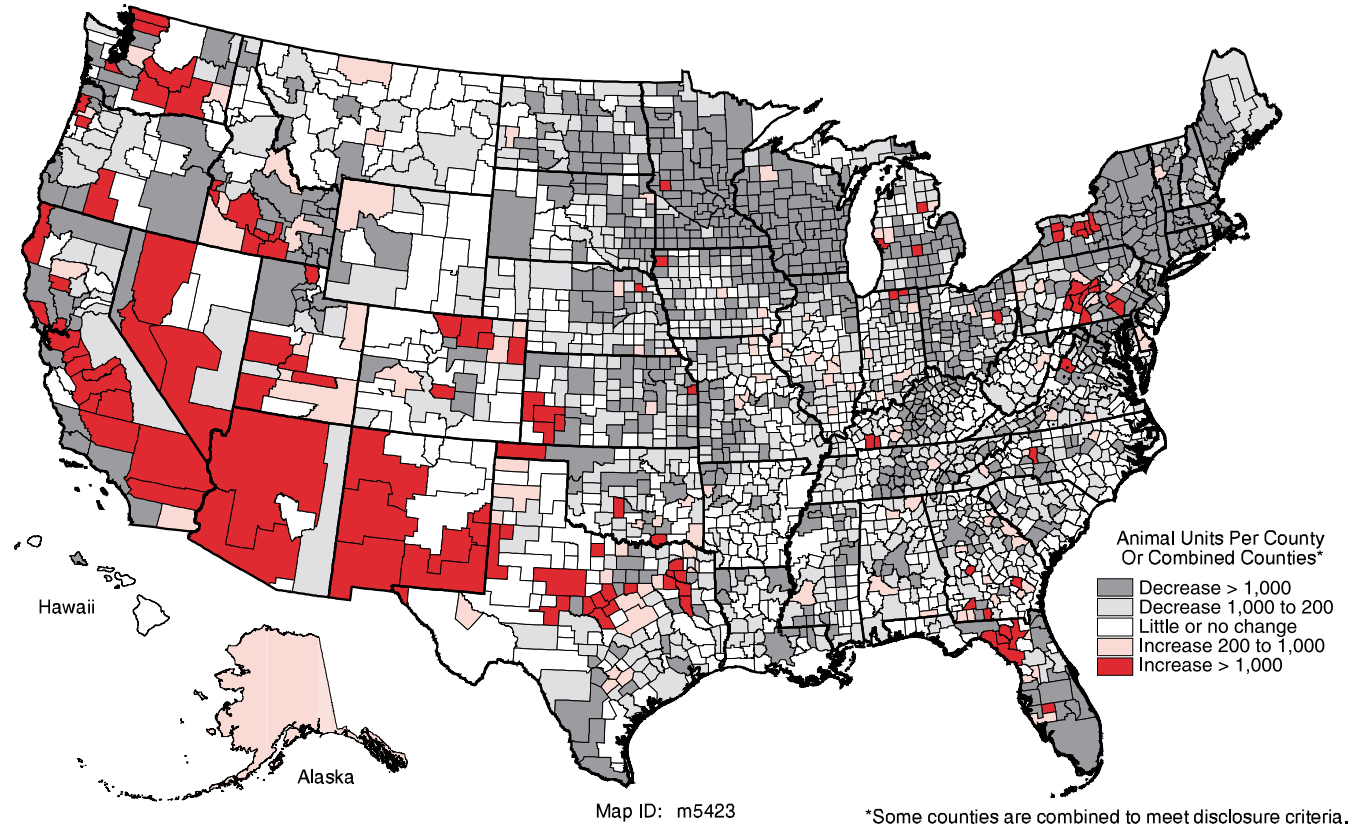
Map 12 Animal units for confined milk cows, 1997



Map ID: m5422

*Some counties are combined to meet disclosure criteria.

Map 13 Change in animal units for confined milk cows from 1982 to 1997

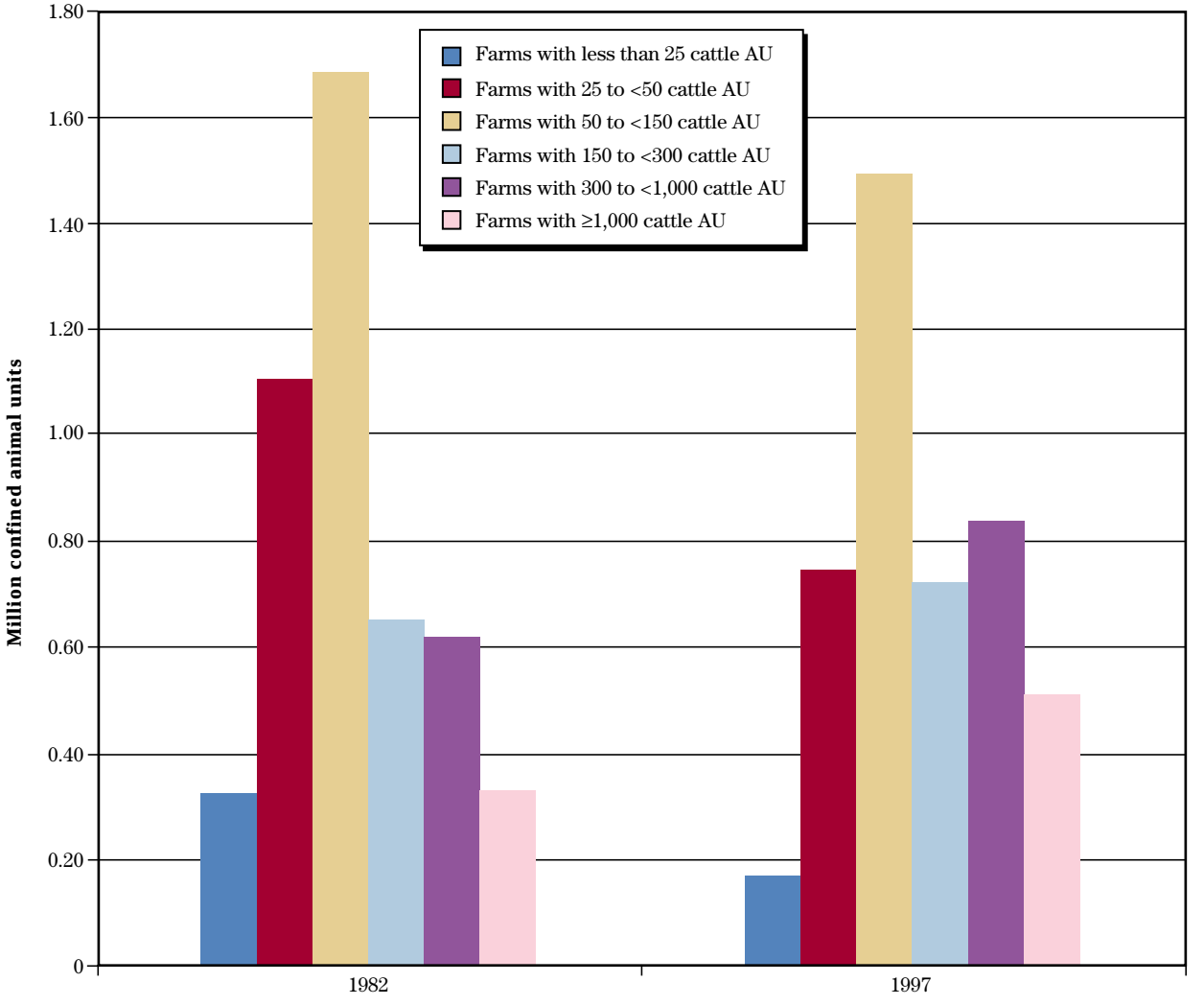


Map ID: m5423

*Some counties are combined to meet disclosure criteria.

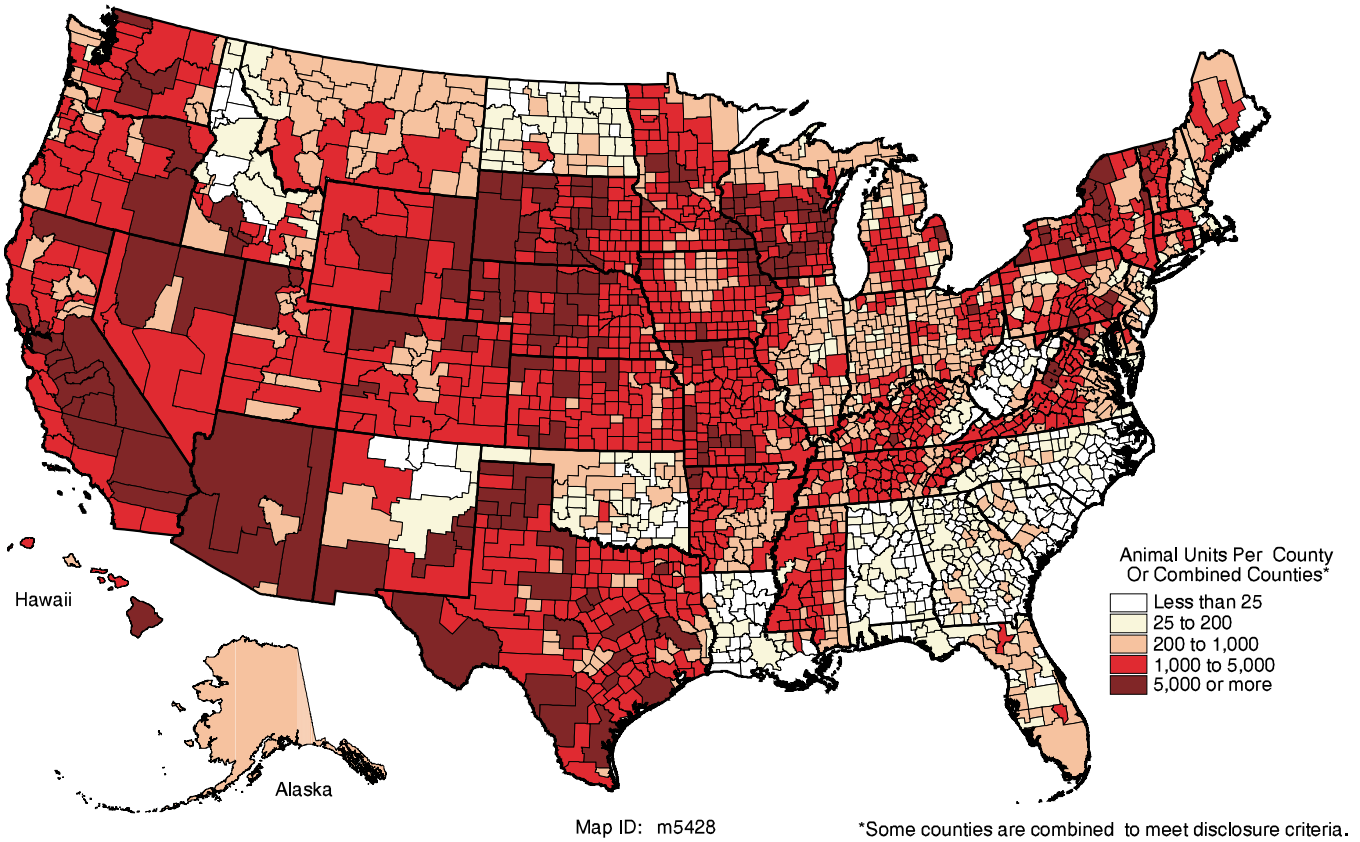
Other beef and dairy animal units fluctuated between 56 and 60 million between 1982 and 1997. The vast majority of these (over 90 percent) were not held in confinement. Other beef and dairy animal units held in confinement represented about 12 to 13 percent of all confined livestock. Other beef and dairy animal units decreased slightly (5 percent) between 1982 and 1997. The number of livestock operations with other beef and dairy animal units showed the same pattern of change observed for the other four major livestock types—loss of small operations and gain in large operations—but the changes are less dramatic (appendix A, table A-1). Overall, livestock operations with other beef and dairy animal units decreased 22 percent (table 5). The distribution of confined animal units for other beef and dairy by farm size did not change substantially from 1982 to 1997. However, reductions occurred in confined animal units for small operations and increases occurred in confined animal units for the largest operations (fig. 14). Confined other beef and dairy are most abundant in the West and in the dairy areas in the North Central States and the Northeast (map 14). Increases in confined other beef and dairy occurred throughout much of Texas, New Mexico, Colorado, Wyoming, South Dakota, and California (map 15). Decreases were concentrated in Iowa and surrounding areas, Arizona, Mississippi, southern Texas, and the Northeast.

Figure 14 Confined other beef and dairy animal units by farm size, 1982 and 1997*



* Size classes are based on total other beef and dairy cattle on farms, including both confined cattle and cattle not held in confinement.

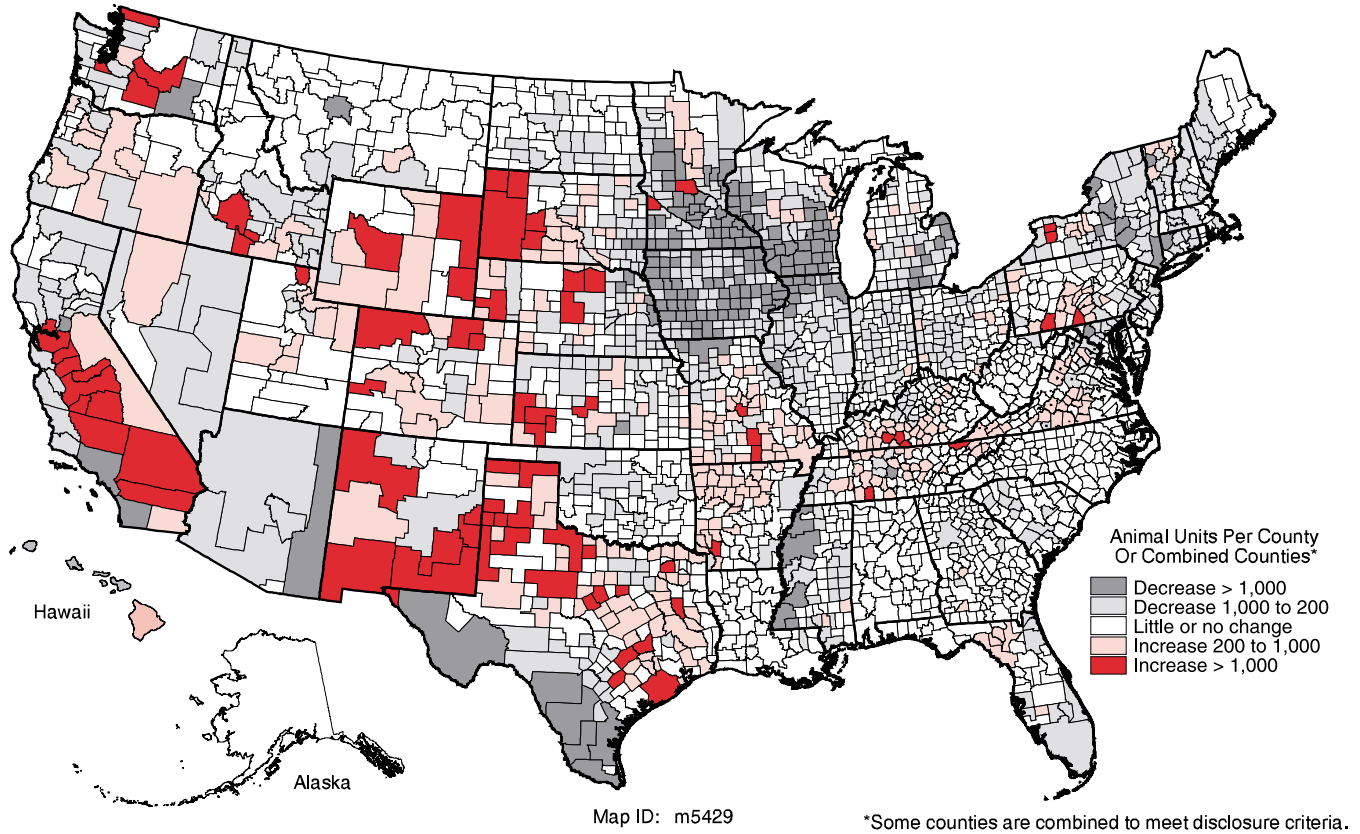
Map 14 Animal units for confined other beef and dairy cattle, 1997



Map ID: m5428

*Some counties are combined to meet disclosure criteria.

Map 15 Change in animal units for confined other beef and dairy cattle from 1982 to 1997

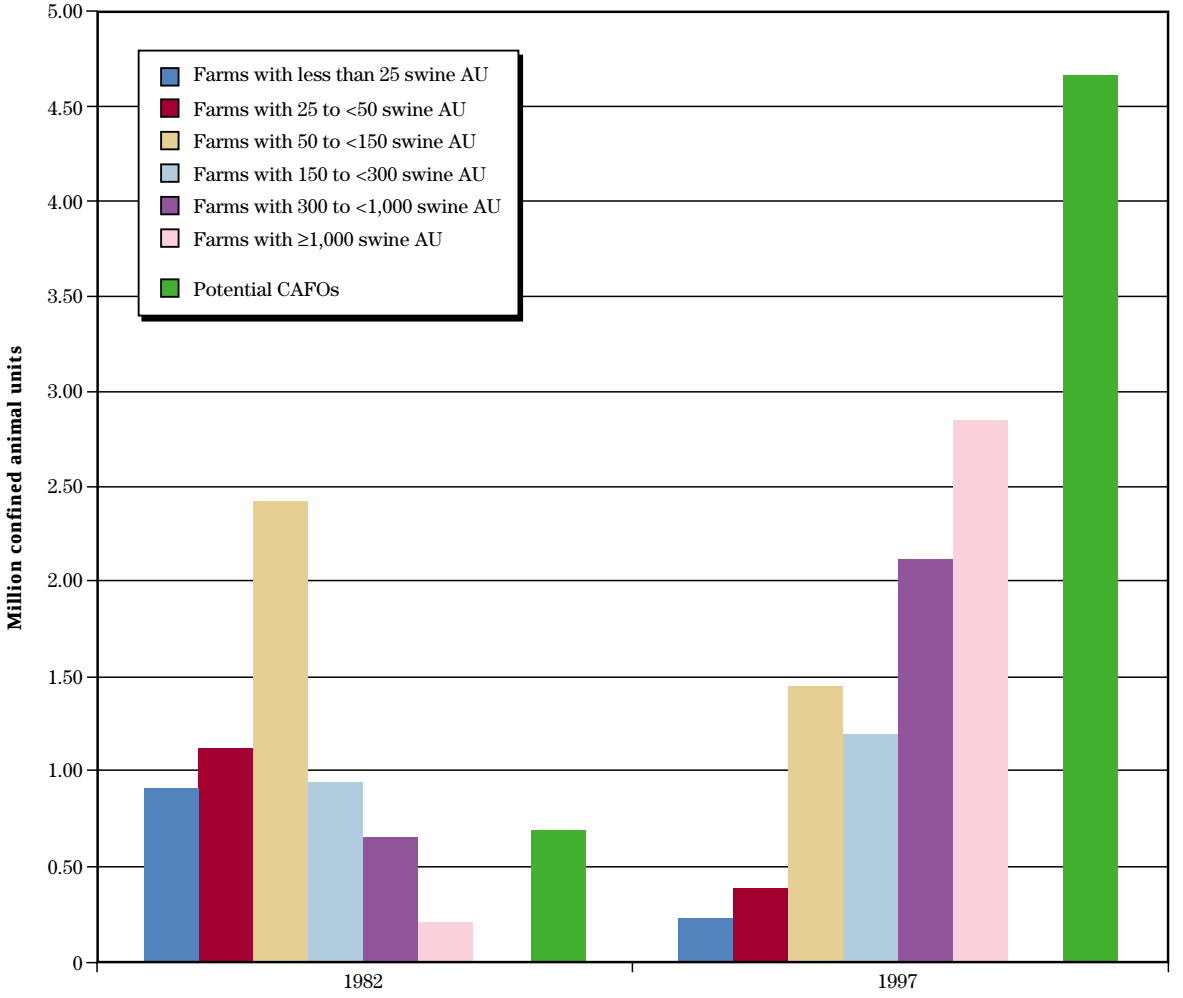


Map ID: m5429

*Some counties are combined to meet disclosure criteria.

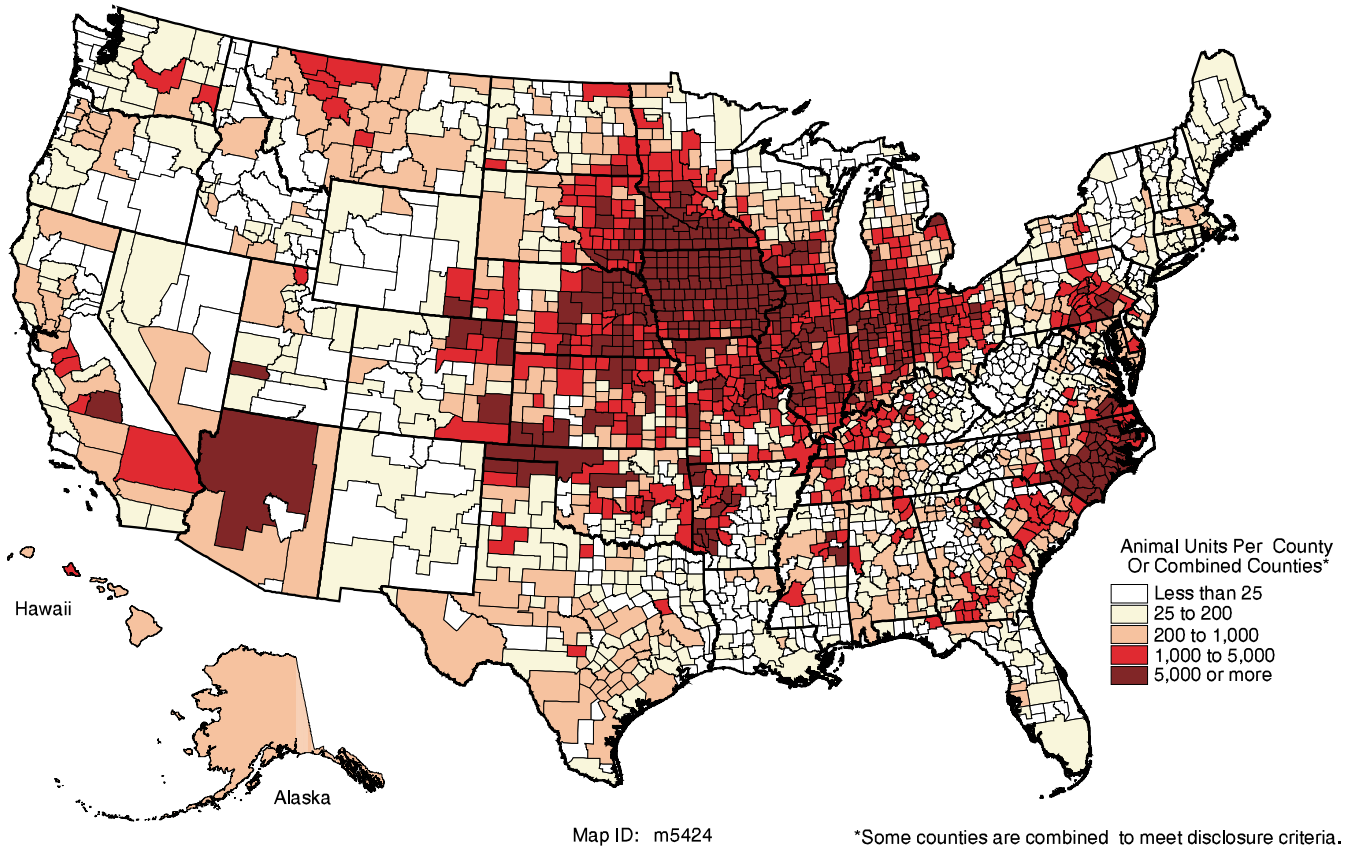
Swine animal units (confined and not confined) increased 16 percent between 1982 and 1997 (from 7.3 million in 1982 to 8.5 million in 1997) (table 5). Confined swine animal units increased at twice this rate—31 percent—as the percentage of swine held in confinement increased from 86 percent in 1982 to 97 percent in 1997. At the same time, the loss of livestock operations with swine was greater than any other major livestock type; livestock operations with swine fell 67 percent overall (64 percent for confined swine operations) between 1982 and 1997. Operations with less than 150 swine animal units fell 70 percent, while the largest operations (1,000 or more swine animal units) increased from 103 in 1982 to 1,011 in 1997—a tenfold increase (appendix A, table A–1). With the increase in confined animal units and the substantial decrease in smaller operations, the shift in the distribution of confined animal units from small operations to large operations was more dramatic for swine than for any other major livestock type (fig. 15). In 1982, only 14 percent of confined swine were on operations with 300 or more swine animal units; by 1997, this had increased to 60 percent. Confined swine animal units on the largest operations (1,000 or more swine animal units) increased 12-fold, while confined swine animal units on the smallest operations (less than 50 swine animal units) fell about 70 percent (appendix A, table A–4). Confined swine are generally concentrated in the Midwest (especially Iowa) and areas in Pennsylvania and North Carolina (map 16). Counties with increases in confined swine between 1982 and 1997 are scattered throughout the area of production, but areas of concentration are in Oklahoma, Arkansas, North Carolina, and northern Iowa and southern Minnesota (map 17). Similarly, areas with decreases are generally scattered throughout the production area.

Figure 15 Confined swine animal units by farm size, 1982 and 1997*



* Size classes are based on total swine on farms, including both confined swine and swine not held in confinement.

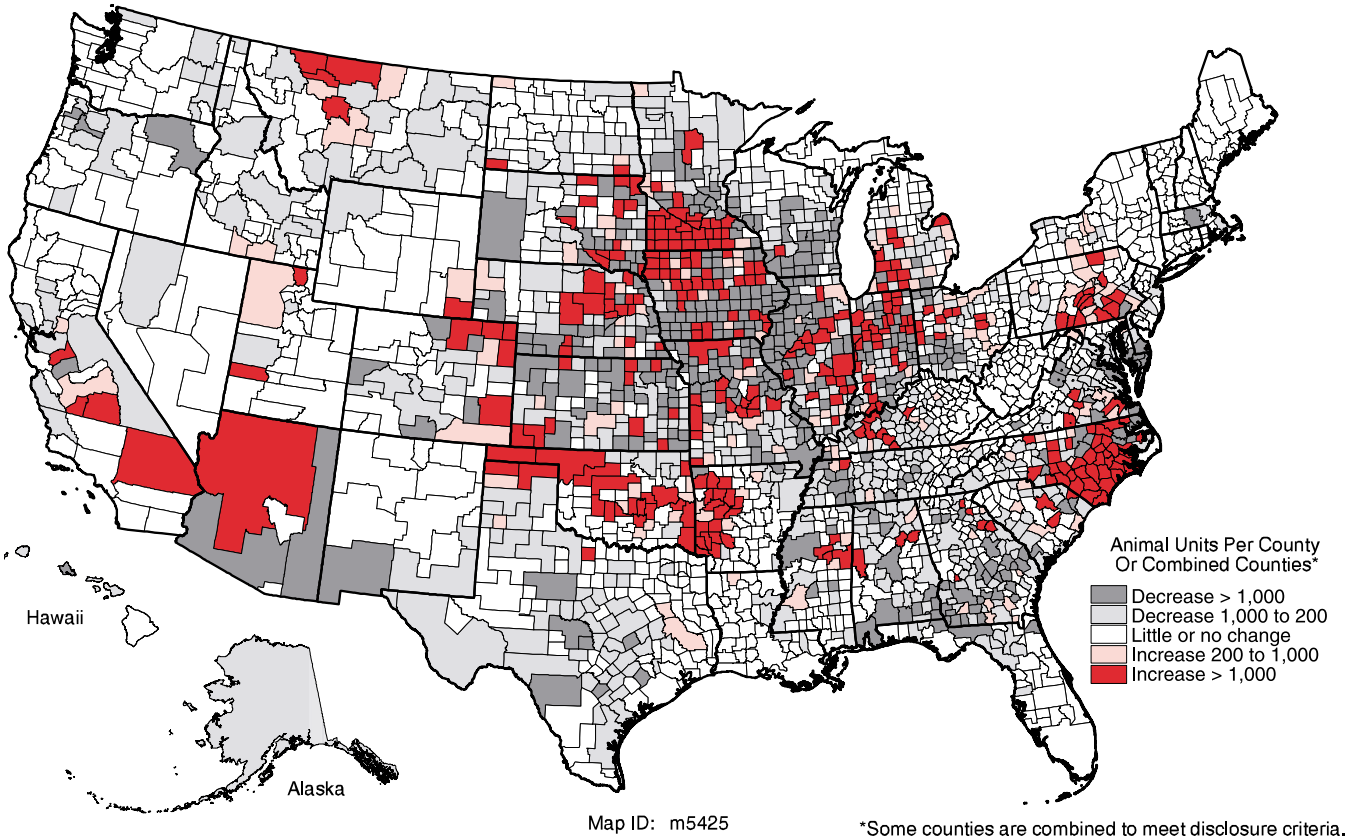
Map 16 Animal units for confined swine, 1997



Map ID: m5424

*Some counties are combined to meet disclosure criteria.

Map 17 Change in animal units for confined swine from 1982 to 1997

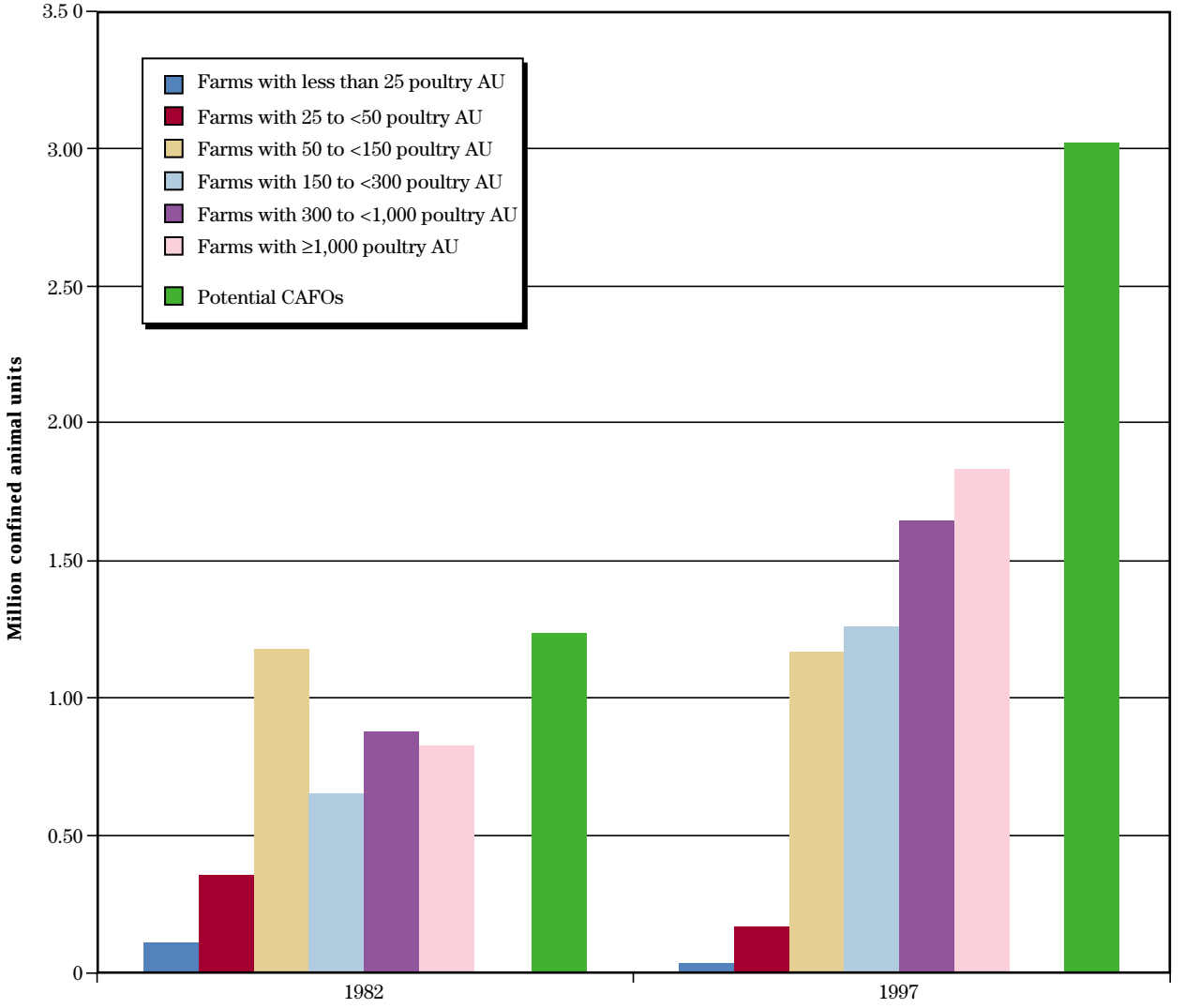


Map ID: m5425

*Some counties are combined to meet disclosure criteria.

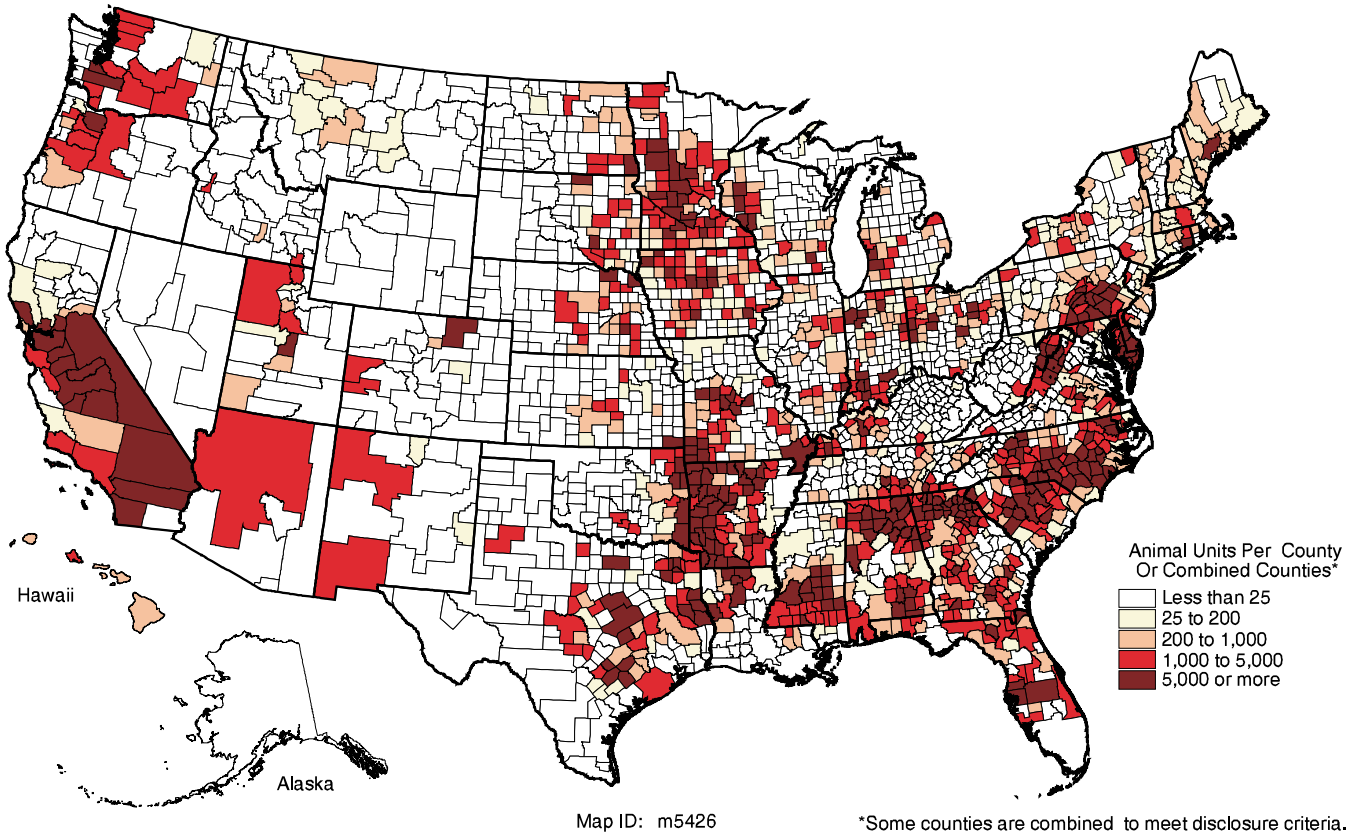
The livestock type with the greatest increase in animal units over the period was poultry. Poultry animal units increased from 4.0 million in 1982 to 6.1 million in 1997, an increase of 52 percent (table 5). Virtually all poultry were confined. Nevertheless, the decrease in the number of operations with poultry was dramatic—46 percent for operations with confined poultry. As observed for other livestock types, these losses were limited to the smaller operations (appendix A, table A–1). Operations with 1,000 poultry animal units or more increased 218 percent, which increased the number of poultry animal units by about 1 million from 1982 to 1997. The change in the distribution of confined poultry by farm size is shown in figure 16. Poultry populations tend to be concentrated in specific regions of the country, notably Arkansas and portions of adjacent states, eastern Texas, Alabama, southern Mississippi, Florida, Georgia, North and South Carolina, part of the mid-Atlantic States, Minnesota and the surrounding area, California, and western Washington and Oregon (map 18). Most of these areas showed increases in confined poultry between 1982 and 1997, but decreases occurred in scattered counties throughout the production area (map 19).

Figure 16 Confined poultry animal units by farm size, 1982 and 1997*



* Size classes are based on total poultry on farms, including both confined poultry and poultry not held in confinement.

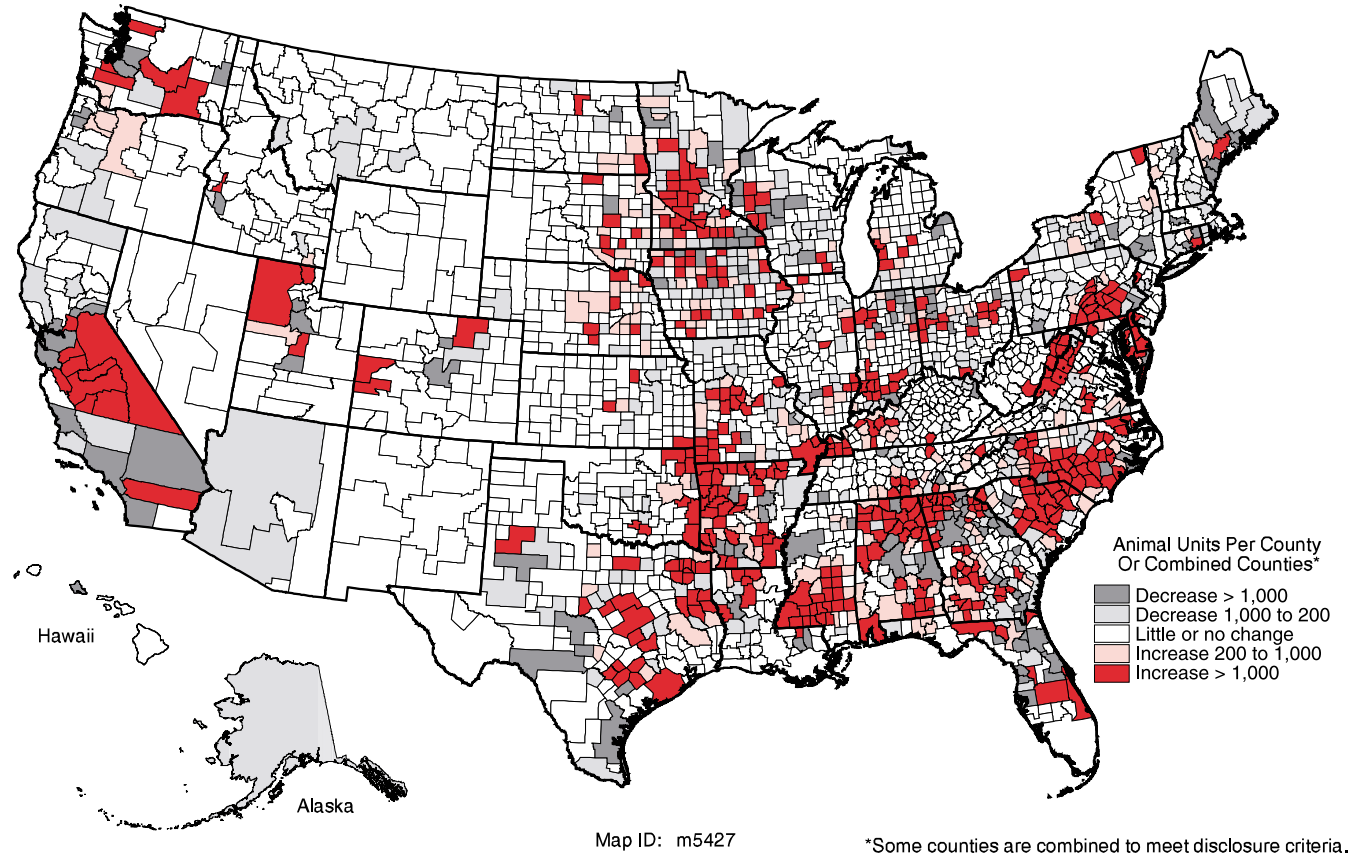
Map 18 Animal units for confined poultry, 1997



Map ID: m5426

*Some counties are combined to meet disclosure criteria.

Map 19 Change in animal units for confined poultry from 1982 to 1997



Map ID: m5427

*Some counties are combined to meet disclosure criteria.

Although the overall number of confined animal units has increased only slightly over the period, the mix of livestock types has shifted significantly. In 1982, 32 percent of the confined animal units were milk cows. By 1997, the share for milk cows had fallen to 26 percent. Shares for fattened cattle and other beef and dairy each fell about 1 percentage point. These drops were offset, however, by increases in the shares for poultry (5 percentage points) and swine (4 percentage points). The shares of confined animal units for 1982 and 1987 are:

	Percent of confined AU		Change in percent
	1982	1997	1982 to 1997
Fattened cattle	25.7	24.5	–1.2
Milk cows	32.0	26.0	–6.0
Other beef and dairy cattle	13.2	11.8	–1.4
Swine	17.8	21.6	+3.8
Poultry	11.3	16.1	+4.8
All types	100.0	100.0	0

Manure production and farmland assimilative capacity

Estimating manure production, assimilative capacity, and excess manure nutrients

Estimates of manure production and land available for application were made using the animal unit estimates described in the previous section and additional information from the census of agriculture on crops grown and pastureland available on each farm.

Estimating quantity of manure and manure nutrients

The quantity of manure was estimated on an *as excreted* basis. For manure nutrients, two kinds of estimates were made: estimates on an *as excreted* basis, and estimates for confined animals after adjusting for expected losses of nutrients during collection, transfer, storage, and treatment. Manure nutrient estimates on an *as excreted* basis were made to provide an estimate of the total amount of manure nutrients produced by all livestock, including livestock not held in confinement. The second estimate represents recoverable manure nutrients, which is the quantity of manure nutrients that would be available for land application or utilization for other purposes.

The quantity of manure was estimated by multiplying standard values for the amount of manure per animal unit per year times the average annual number of animal units for each of the 16 livestock categories. Manure nitrogen and manure phosphorus were calculated by multiplying the tons of manure times standard values for the pounds of elemental nutrients per ton of manure. The total amount of manure nitrogen and phosphorus produced by all livestock was calculated using quantities of manure nitrogen and phosphorus *as excreted*. Estimates of *as excreted* manure nutrients were also made for confined livestock alone.

Recoverable manure nutrients were estimated using animal units for confined livestock, a factor for manure recoverability, and estimates of the pounds of nutrients per ton of manure after nutrient losses during collection, transfer, storage, and treatment. Equation 57 was used to calculate recoverable manure nutrients.

Parameters used to estimate manure nutrients for each of the 16 livestock categories are shown in table 8. For nonpoultry livestock categories, parameters for the nutrient portion of manure range from 0.5 to 2.2 pounds of nitrogen per ton of manure *(as excreted)* and from 0.1 to 0.7 pounds of phosphorus per ton of manure. Parameters for the nutrient content of manure for poultry categories are higher, ranging from 1.8 to 3.7 pounds of nitrogen per ton of manure and from 0.5 to 1.4 pounds of phosphorus per ton of manure.

Manure nutrient losses during collection, storage, treatment, and transfer include volatilization of nitrogen, spillage, and manure nutrients carried from the confinement facilities by rainfall and runoff. Only waste treatment technologies that are in common practice were considered in estimating these losses. Assumptions for manure nitrogen losses ranged from 32 percent for chicken layers to 75 percent for swine.

$$\text{Recoverable manure nutrients} = (\text{tons manure per AU}) \times (\text{confined AU}) \times (\text{recoverability factor}) \times (\text{nutrients per ton of manure after losses}) \quad \text{[eq. 57]}$$

Table 8 Parameters used to calculate the quantity of manure and manure nutrients for the 16 livestock categories

Livestock category	Tons of manure per animal unit per year as excreted	-- Pounds of nitrogen per ton -- of manure*		-- Pounds of phosphorus -- per ton of manure*	
		As excreted	After losses	As excreted	After losses
Fattened cattle	10.59	10.98	4.39	3.37	2.86
Milk cows	15.24	10.69	4.30	1.92	1.65
Other beef and dairy					
Beef calves, from calving to about 500 pounds	11.32	8.52	2.56	2.33	1.98
Beef heifers for replacement herds	12.05	6.06	1.82	1.30	1.10
Beef breeding herds (cows and bulls)	11.50	10.95	3.30	3.79	3.23
Beef stockers and grass fed beef	11.32	8.52	2.56	2.33	1.98
Dairy calves, from calving to about 500 pounds	12.05	6.06	1.82	1.30	1.10
Dairy heifers for replacement herds	12.05	6.06	1.82	1.30	1.10
Dairy stockers and grass fed animals marketed as beef	12.05	6.06	1.82	1.30	1.10
Swine					
Breeding hogs	6.11	13.26	3.32	4.28	3.62
Hogs for slaughter	14.69	11.30	2.82	3.29	2.80
Poultry					
Chickens, layers	11.45	26.93	18.46	9.98	8.50
Chickens, pullets	8.32	27.20	13.60	10.53	8.95
Chickens, broilers	14.97	26.83	16.10	7.80	6.61
Turkeys for breeding	9.12	22.41	11.20	13.21	11.23
Turkeys for slaughter	8.18	30.36	16.18	11.83	10.06

* Includes nitrogen and phosphorus in urine.
Note: Values in this table are the same as those previously published by Lander, Moffitt, and Alt (1998).

Assumptions for manure phosphorus losses were much lower—15 to 16 percent for all livestock categories. Recoverability factors, presented in table 3, represent the proportion of the manure that could reasonably be expected to be collected from the confinement facility and applied to the land.

A variety of sources was used to obtain manure characteristics. These sources are documented in Moffitt and Lander (1997), and a summary is presented in Lander, Moffitt, and Alt (1998). A single set of parameters for manure characteristics was used for all census years, all farm sizes, and all regions of the country. The manure characteristics data base was drawn from literature of the late 1980s and early 1990s, so the parameters generally represent the mid-point of the period for which they were used in this study to derive estimates of manure nutrients. Recoverability factors represent practices for the mid-1990s. However, changes in breeding stock and feed characteristics would have resulted in differences in manure characteristics over the period. Regional differences and differences by farm size could also occur where production technologies differ by region or farm size. (Updating parameter estimates to reflect current practices in the livestock industry and creating estimates specifically tailored for earlier years are significant tasks that will require participation by several USDA agencies and selected universities.)

Estimating assimilative capacity of cropland and pastureland

The assimilative capacity (or land application capacity) is an estimate of the amount of nutrients that could be applied to land available for manure application without building up nutrient levels in the soil over time. The capacity of cropland and pastureland to assimilate nutrients was calculated for all farms, with or without livestock. Acres of 24 crops, cropland used as pasture, and half of the permanent pasture were assumed available for manure application. (Half of the permanent pastureland was assumed to be inaccessible to manure-handling equipment because of rough terrain or trees and brush.) Farmland in other uses (woodland, idle cropland, orchards, and other crops) may be available for specific livestock operations, but generally, this land is not well suited to raw manure application.

For cropland, assimilative capacity is estimated to be the amount of nutrients taken up by the crop and removed at harvest. These estimates are for *actual* assimilative capacity, reflecting the specific crop yields during each of the four census years, which can vary from farm to farm and year to year. (A useful additional measure would be *potential* assimilative capacity, where longer term average regional yields are used to estimate potential uptake and removal at harvest.) If no more nutrients were added to the land than was taken up and removed at harvest, nutrients would not build up to excessive levels in the soil, and thus would not be as available for leaching or runoff.

Estimates of the pounds of nitrogen and phosphorus per unit of crop yield were taken from Lander, Moffitt, and Alt (1998) and are presented in table 9. These estimates were multiplied times production (bushels, pounds, tons, bales) for each of the 24 crops on each farm to estimate the assimilative capacity of cropland. A nitrogen efficiency factor was included in the calculation for nitrogen to account for the fact that, generally, only about 70 percent of the nitrogen applied is available to the crop. Thus, to get the crop yields reported in the census of agriculture, 43 percent more nitrogen needed to be applied than was actually taken up. This additional nitrogen was included in the calculation of assimilative capacity although a portion of it would be available for volatilization, leaching, or runoff.

For cropland used as pasture, it was assumed that 75 pounds per acre of nitrogen and 30 pounds per acre of phosphorus could be applied without accumulating nutrients in the soil, in part because of the removal of nutrients by grazing animals. For permanent pastureland, lower application rates were used—28 pounds per acre for nitrogen and 11 pounds per acre for phosphorus—to account for the generally lower productivity of the soils and less intensive management associated with permanent pastureland as compared to cropland used as pastureland. The census of agriculture does not report the acreage of permanent pastureland per farm, but does report the acres of rangeland and pastureland combined. The 1992 National Resources Inventory (NRI) was used to estimate the percentage of pastureland and rangeland that was pastureland by county for the four census of agriculture years used in this study. These percentages were multiplied times the acres of pastureland and rangeland in the census of agriculture for each farm in the respective counties to obtain estimates of the acreage of permanent pastureland on the farm.

(The assimilative capacity parameters used for cropland used as pasture are based on the assumption that the land was frequently rotated with cropland. In the census, however, some of the land designated as *cropland used as pasture* is rarely used as cropland. Where this is the case, the assimilative capacity has been overstated. Using the per acre assimilative capacity assumptions for permanent pastureland (28 pounds per acre for nitrogen and 11 pounds per acre for phosphorus) to represent per acre assimilative capacity for cropland used as pasture, estimates of total assimilative capacity were 7 percent lower for nitrogen and 19 percent lower for phosphorus nationally. In some areas of the country (Hawaii, West Virginia, Oklahoma, Texas, and Alabama), total assimilative capacity estimates were as much as 25 percent lower for nitrogen and 35 percent lower for phosphorus.)

Table 9 Nutrient uptake parameters for 24 crops used to estimate assimilative capacity of cropland

Crop	Yield unit	-- Pounds of nutrients per yield unit -- Nitrogen	Phosphorus	-- Pounds of nutrients per ton of product -- Nitrogen	Phosphorus
Corn for grain	bushels	0.80	0.15	28.57	5.36
Corn for silage	tons	7.09	1.05	7.09	1.05
Soybeans	bushels	3.55	0.36	118.33	12.00
Sorghum for grain	bushels	0.98	0.18	35.00	6.43
Sorghum for silage	tons	14.76	2.44	14.76	2.44
Cotton (lint and seed)	bales	15.19	1.89	60.76	7.56
Barley	bushels	0.90	0.18	37.50	7.50
Winter wheat	bushels	1.02	0.20	34.00	6.67
Durum wheat	bushels	1.29	0.22	43.00	7.33
Other spring wheat	bushels	1.39	0.23	46.33	7.67
Oats	bushels	0.59	0.11	36.88	6.88
Rye for grain	bushels	1.07	0.18	38.21	6.43
Rice	bags	1.25	0.29	25.00	5.80
Peanuts for nuts (with pods)	pounds	0.040	0.003	80.00	6.00
Sugar beets for sugar	tons	4.76	0.94	4.76	0.94
Tobacco					
IN, MO, OH, and WV	pounds	0.0298	0.0024	59.60	4.80
KY	pounds	0.0299	0.0024	59.80	4.80
NC	pounds	0.0329	0.0020	65.80	4.00
TN	pounds	0.0302	0.0023	60.40	4.60
VA	pounds	0.0322	0.0021	64.40	4.20
all other states	pounds	0.0330	0.0020	66.00	4.00
Potatoes	bags	0.36	0.06	7.20	1.20
Sweet potatoes	bushels	0.13	0.02	5.20	0.80
Alfalfa hay	tons	50.40	4.72	50.40	4.72
Small grain hay	tons	25.60	4.48	25.60	4.48
Other tame hay	tons	19.80	15.30	19.80	15.30
Wild hay	tons	19.80	15.30	19.80	15.30
Grass silage	tons	13.60	1.60	13.60	1.60
Sorghum hay	tons	2.39	1.01	2.39	1.01

Note: Values in this table are the same as those previously published by Lander, Moffitt, and Alt (1998).

The National Resources Inventory is a national survey of private land use conducted by NRCS every 5 years. The inventory is based on about 800,000 sample points throughout the 48 states, including cropland, pastureland, rangeland, forest land, urban land, and other uses of private land. The percentage of pastureland was estimated using data for 1982, 1987, and 1992 from the 1992 NRI and applied to the respective census years. The 1992 estimate was used for the 1997 Census.

Estimating excess nutrients

Farms that produce more manure nutrients than can be applied to the land without accumulating nutrients in the soil have excess manure nutrients. In some cases a farm has sufficient cropland and pastureland to properly utilize the manure on the farm. In other cases the farm operator must use land owned or operated by others to avoid overapplying manure.

The extent to which livestock operations use off-farm land to dispose of animal waste is not available from the census of agriculture, so a precise estimate of excess nutrients cannot be determined. However, two useful estimates can be made to provide perspective on the potential for excess manure nutrients. The first assumes that only land on the farm is available for land application of manure. This estimate is called *farm-level excess manure nutrients,* and is clearly an overestimate of actual excess manure nutrients. The second estimate assumes that all suitable cropland and pastureland within a county are available for manure application. This estimate, called *county-level excess manure nutrients,* is an underestimate since it is, in most cases, not economically feasible to transport manure throughout an entire county, nor would all farmers within a county permit manure application on their land. (Commercial fertilizer also contributes to excess nutrients, but only manure nutrients are included in this analysis.) Excess manure nutrients were estimated as shown in equation 58.

This calculation was made for each farm for farm-level excess manure nutrients. If the value was a negative number (indicating that more land was available than needed on that farm), excess manure nutrients were set equal to zero. For county-level excess manure nutrients, the sums included recoverable manure nutrients for all confined animals in the county and all acres of cropland (24 crops) and pastureland in the county. Again, negative values for county-level estimates were set equal to zero.

The ratio of manure nutrient availability to the assimilative capacity of cropland and pastureland in a county was also calculated to identify counties that have a potential problem with animal waste utilization and disposal. It was also used to identify counties that may have less serious problems or may have problems in the future. The calculation is shown in equation 59.

Status and trends

Trends in manure nutrients and excess manure nutrients are directly related to trends in animal units. As livestock operations have become fewer, larger, and more concentrated in the major production areas, manure nutrients have also increased in production areas. In addition, the increased share of poultry in the mix of livestock increases the concentration of manure nutrients even more because poultry have 2 to 4 times as much manure nutrients per ton of manure as other livestock types.

Manure nutrients

In 1997, 12.9 billion pounds of manure nitrogen and 3.8 billion pounds of manure phosphorus *(as excreted)* were produced by the 95 million animal units in the U.S., representing increases of 3 percent and 5 percent over 1982 amounts, respectively (tables 10 and 11, figs. 17 and 18). About half of these nutrients were produced by livestock held in confinement.

$$\text{Excess manure nutrients} = \left(\text{sum over livestock categories of manure nutrients available for application}\right) - \left(\text{sum over cropland and pastureland of assimilative capacity}\right) \quad \text{[eq. 58]}$$

$$\text{Ratio} = \frac{\left(\text{manure nutrients available for application in county}\right)}{\left(\text{assimilative capacity in county}\right)} \quad \text{[eq. 59]}$$

Table 10 Manure nitrogen produced on livestock operations by animal type and farm size, 1982–1997

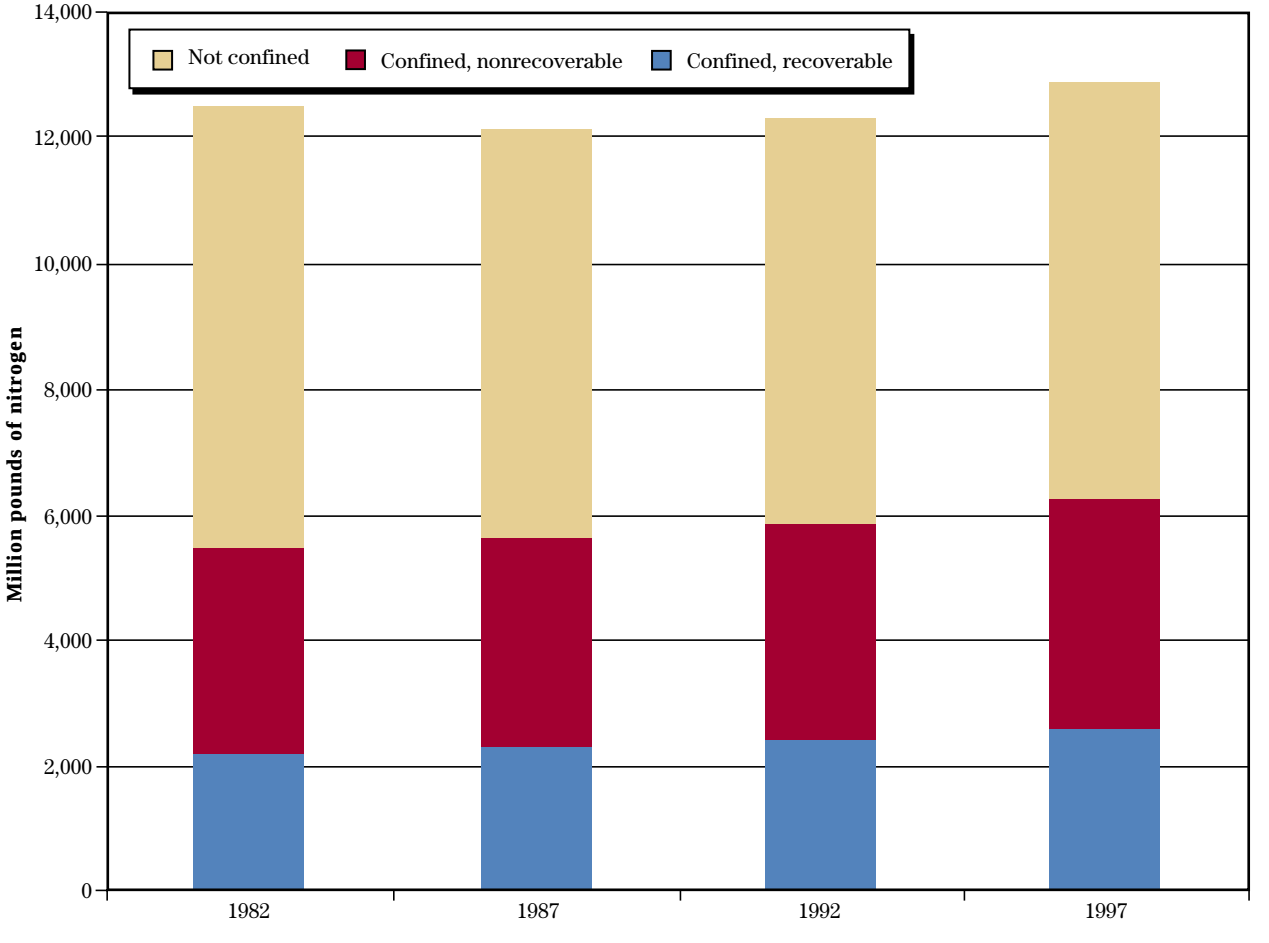
Category of livestock operations	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
	--- Million pounds of manure nitrogen as excreted, all livestock ---					
Livestock type*						
Fattened cattle	1,128.7	1,134.7	1,077.2	1,114.9	–13.8	–1
Milk cows	2,387.1	2,219.3	2,089.2	2,002.1	–385.0	–16
Other beef and dairy	6,708.3	6,240.0	6,359.0	6,617.1	–91.3	–1
Swine	996.9	976.6	1,080.6	1,197.5	200.6	+20
Poultry	1,276.5	1,532.7	1,707.1	1,973.5	696.9	+55
All livestock types	12,497.5	12,103.3	12,313.0	12,905.0	407.5	+3
Farm size**						
Less than 25 total AU	878.3	765.8	680.4	635.9	–242.4	–28
25 to <50 total AU	1,207.9	1,058.9	970.4	892.6	–315.2	–26
50 to <150 total AU	3,913.7	3,496.1	3,247.7	2,888.2	–1,025.5	–26
150 to <300 total AU	2,288.2	2,229.5	2,304.7	2,293.9	5.6	0
300 to <1,000 total AU	2,215.1	2,293.5	2,540.4	2,843.9	628.8	+28
1,000 or more total AU	1,994.3	2,259.4	2,569.5	3,350.5	1,356.2	+68
All livestock operations	12,497.5	12,103.3	12,313.0	12,905.0	407.5	+3
	Million pounds of manure nitrogen as excreted, confined livestock					
Livestock type*						
Fattened cattle	1,059.0	1,078.3	1,034.6	1,083.5	24.5	+2
Milk cows	1,851.8	1,751.6	1,662.4	1,612.6	–239.2	–13
Other beef and dairy	458.0	429.1	435.9	443.1	–14.9	–3
Swine	851.6	862.0	989.8	1,155.4	303.8	+36
Poultry	1,272.6	1,530.1	1,705.6	1,972.2	699.6	+55
All livestock types	5,493.1	5,651.0	5,828.3	6,266.8	773.7	+14
Farm size**						
Less than 25 total AU	87.4	74.9	56.2	31.0	–56.4	–65
25 to <50 total AU	317.4	264.3	206.9	145.2	–172.2	–54
50 to <150 total AU	1,878.0	1,685.6	1,473.0	1,156.0	–722.0	–38
150 to <300 total AU	1,091.5	1,109.9	1,168.7	1,142.5	51.1	+5
300 to <1,000 total AU	946.0	1,060.5	1,213.4	1,437.7	491.7	+52
1,000 or more total AU	1,172.9	1,455.8	1,710.1	2,354.4	1,181.5	+101
All confined livestock operations	5,493.1	5,651.0	5,828.3	6,266.8	773.7	+14
	Million pounds of recoverable manure nitrogen (available for application)					
Livestock type*						
Fattened cattle	381.1	388.0	372.3	389.9	8.8	+2
Milk cows	730.0	690.5	655.3	635.7	–94.3	–13
Other beef and dairy	135.0	126.5	128.5	130.6	–4.4	–3
Swine	202.0	204.5	234.8	274.1	72.0	+36
Poultry	756.6	900.5	999.0	1,152.9	396.3	+52
All livestock types	2,204.7	2,310.0	2,389.9	2,583.2	378.5	+17

Table 10 Manure nitrogen produced on livestock operations by animal type and farm size, 1982–1997—Continued

Category of livestock operations	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
Farm size**						
Less than 25 total AU	30.2	25.4	17.8	10.7	–19.5	–65
25 to <50 total AU	124.2	101.4	76.2	55.5	–68.7	–55
50 to <150 total AU	750.8	680.1	595.6	485.1	–265.6	–35
150 to <300 total AU	436.3	453.6	488.3	501.3	65.0	+15
300 to <1000 total AU	388.1	444.4	506.4	599.1	210.9	+54
1000 or more total AU	475.2	605.2	705.6	931.5	456.3	+96
All confined livestock operations	2,204.7	2,310.0	2,389.9	2,583.2	378.5	+17

* Pounds of manure nitrogen are for the specified animal type only, and do not include manure nitrogen from other animal types on the farms.
** Size classes are based on total animal units on farms and include confined livestock and livestock not held in confinement.
Note: A breakdown of the number of livestock operations and animal units by farm size and livestock type is provided in appendix D. A breakdown by enterprise type and farm size is provided in appendix E. State estimates are provided in appendix B.

Figure 17 Manure nitrogen produced by livestock



Reflecting overall changes in animal units, manure nutrient production decreased for milk cows by about 16 percent between 1982 and 1997, stayed about the same for fattened cattle and other beef and dairy, increased about 20 percent for swine, and increased more than 50 percent for poultry (tables 10 and 11, figures 19 and 20).

Of the total amount of manure nutrients produced *(as excreted),* approximately 20 percent of the nitrogen and 35 percent of the phosphorus were recoverable from confinement facilities and thus available for land application (figs. 17 and 18). The remaining nutrients—those that are not recoverable—would have been lost to the atmosphere through volatilization (in the case of nitrogen), taken up by plants growing on land used for grazing, accumulated in the soil, washed off confinement facilities and grazing lands with runoff, or leached into the ground water. Estimating the amount of nutrients entering each of these pathways is beyond the scope of this study.

The difference between the percentage of recoverable nitrogen and recoverable phosphorus is because of volatilization of nitrogen; phosphorus does not volatilize as nitrogen does. See table 8 for differences between nitrogen and phosphorus in the amounts of nutrients in manure *as excreted* versus amounts after losses during collection, transfer, storage, and treatment.

The primary focus for this study is on recoverable manure nutrients for land application. However, because the quantities of nonrecoverable manure nutrients produced each year are large, it is possible that they contribute to water quality degradation in

Figure 18 Manure phosphorus produced by livestock

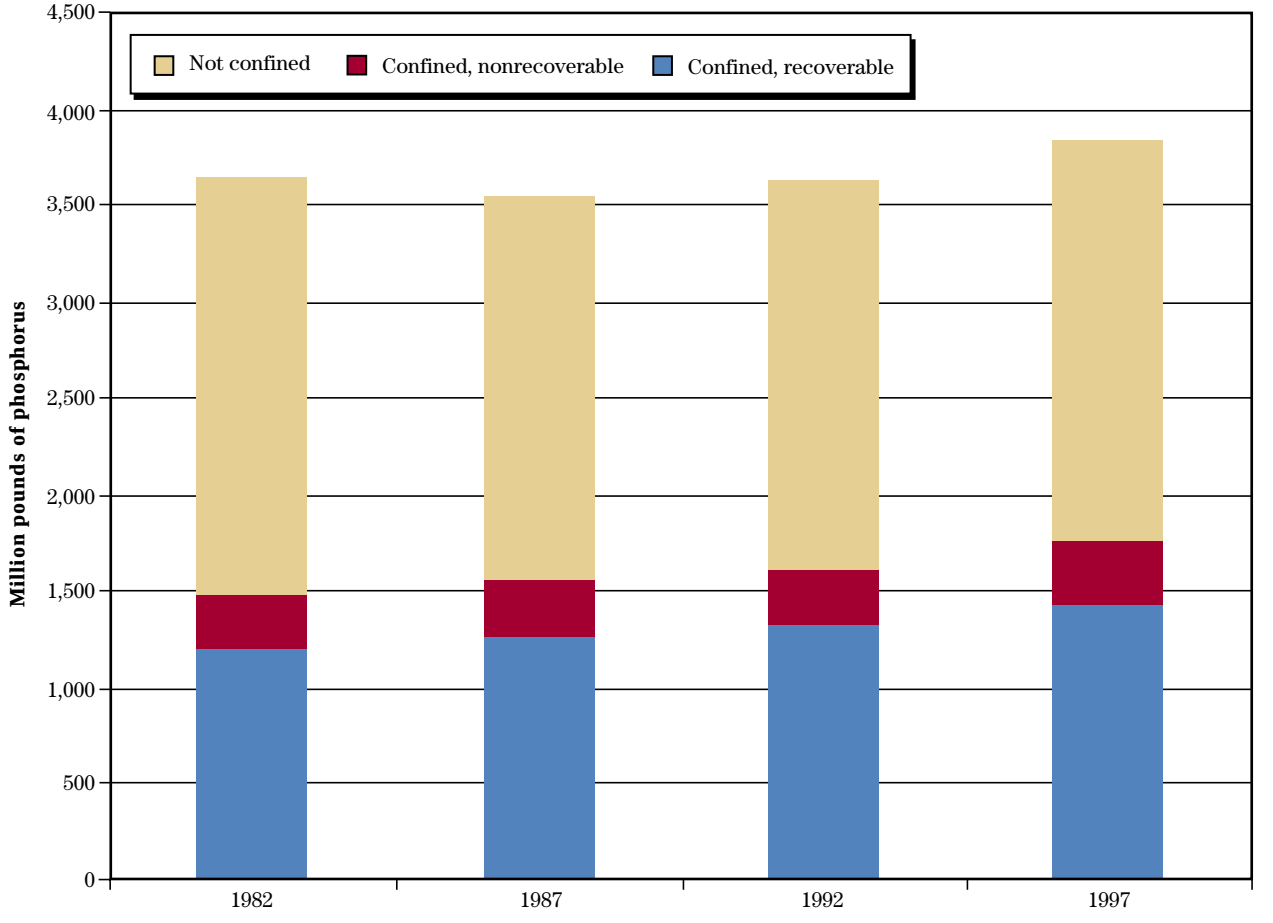


Table 11 Manure phosphorus produced on livestock operations by animal type and farm size, 1982-1997

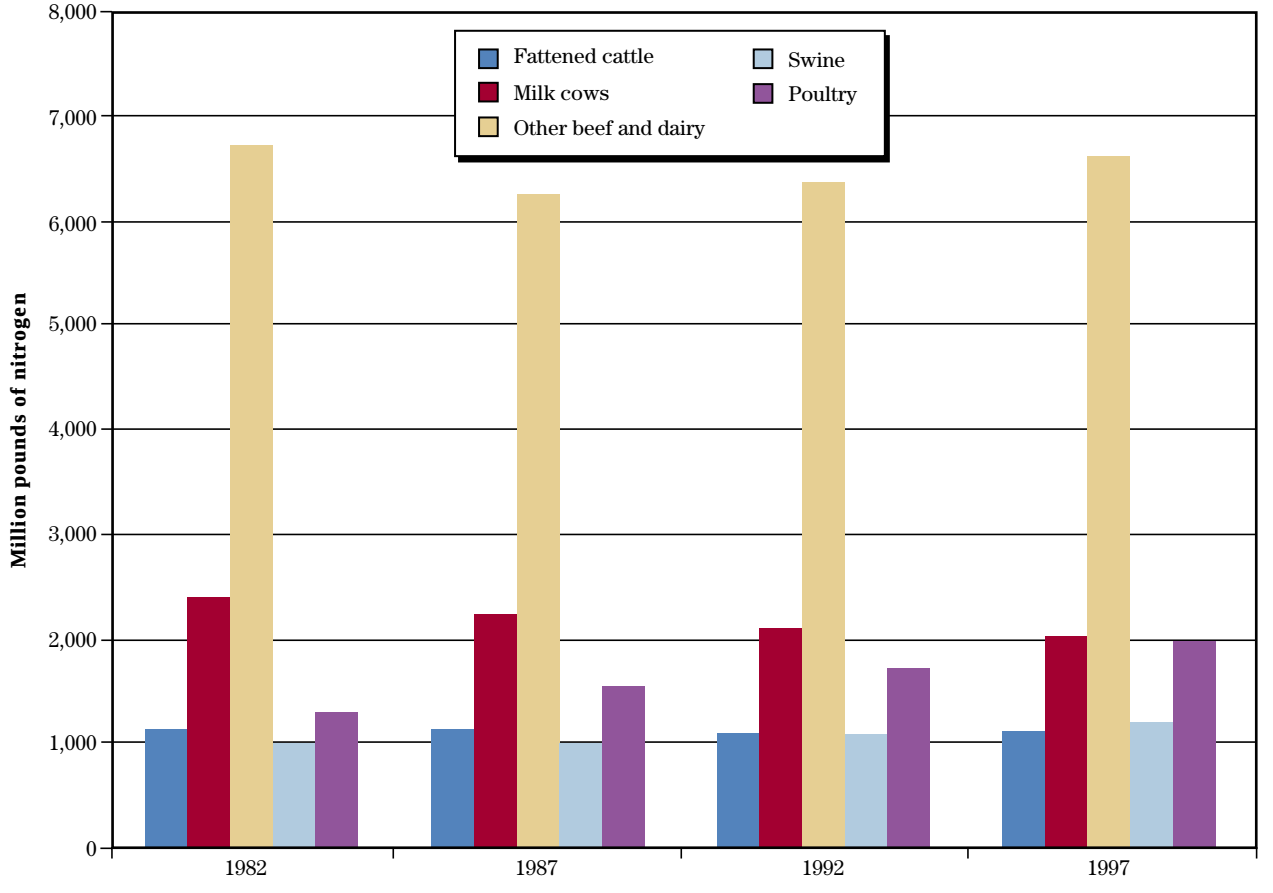
Category of livestock operations	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
	- - Million pounds of manure phosphorus as excreted, all livestock- -					
Livestock type*						
Fattened cattle	346.4	348.3	330.6	342.2	–4.2	–1
Milk cows	428.7	398.6	375.2	359.6	–69.2	–16
Other beef and dairy	2,140.1	1,989.1	2,031.0	2,117.4	–22.7	–1
Swine	296.9	290.9	321.2	355.2	58.3	+20
Poultry	439.3	526.8	580.7	665.9	226.6	+52
All livestock types	3,651.4	3,553.7	3,638.8	3,840.2	188.9	+5
Farm size**						
Less than 25 total AU	274.8	241.8	216.2	203.5	–71.2	–26
25 to <50 total AU	366.6	325.7	303.6	283.5	–83.1	–23
50 to <150 total AU	1,083.8	975.4	925.1	842.7	–241.1	–22
150 to <300 total AU	648.7	629.3	657.0	662.4	13.7	+2
300 to <1,000 total AU	664.9	688.6	760.4	851.8	186.9	+28
1,000 or more total AU	612.5	692.9	776.4	996.2	383.7	+63
All livestock operations	3,651.4	3,553.7	3,638.8	3,840.2	188.9	+5
	Million pounds of manure phosphorus as excreted, confined livestock					
Livestock type*						
Fattened cattle	325.0	331.0	317.5	332.5	7.5	+2
Milk cows	332.6	314.6	298.6	289.6	–43.0	–13
Other beef and dairy	132.8	123.8	126.6	129.9	–2.9	–2
Swine	253.8	257.0	294.4	342.8	89.0	+35
Poultry	437.8	525.8	580.1	665.4	227.6	+52
All livestock types	1,482.0	1,552.2	1,617.2	1,760.2	278.2	+19
Farm size**						
Less than 25 total AU	26.9	22.9	17.1	9.5	–17.4	–65
25 to <50 total AU	88.7	74.9	59.7	42.5	–46.2	–52
50 to <150 total AU	459.4	417.2	370.8	294.7	–164.7	–36
150 to <300 total AU	281.0	285.9	305.8	302.5	21.5	+8
300 to <1,000 total AU	267.8	304.0	346.4	411.7	143.9	+54
1,000 or more total AU	358.2	447.3	517.4	699.4	341.2	+95
All confined livestock operations	1,482.0	1,552.2	1,617.2	1,760.2	278.2	+19
	Million pounds of recoverable manure phosphorus (available for application)					
Livestock type*						
Fattened cattle	248.3	252.8	242.5	254.0	5.7	+2
Milk cows	280.1	264.9	251.5	243.9	–36.2	–13
Other beef and dairy	110.6	103.1	105.5	108.2	–2.4	–2
Swine	204.9	207.5	237.7	276.8	71.9	+35
Poultry	364.6	437.8	482.9	553.9	189.3	+52
All livestock types	1,208.4	1,266.1	1,320.1	1,436.8	228.4	+19

Table 11 Manure phosphorus produced on livestock operations by animal type and farm size, 1982-1997—Continued

Category of livestock operations	1982	1987	1992	1997	Change 1982 to 1997	Percent change 1982 to 1997
Farm size**						
Less than 25 total AU	21.8	18.5	13.8	7.6	–14.1	–65
25 to <50 total AU	72.8	61.4	49.0	35.0	–37.9	–52
50 to <150 total AU	379.6	344.7	306.3	243.9	–135.7	–36
150 to <300 total AU	231.3	235.7	252.3	250.0	18.8	+8
300 to <1,000 total AU	219.4	249.8	285.1	339.1	119.6	+55
1,000 or more total AU	283.5	356.0	413.7	561.2	277.7	+98
All confined livestock operations	1,208.4	1,266.1	1,320.1	1,436.8	228.4	+19

* Pounds of manure phosphorus are for the specified animal type only and do not include manure phosphorus from other animal types on the farms.
** Size classes are based on total animal units on farms and include confined livestock and livestock not held in confinement.
Note: A breakdown of the number of livestock operations and animal units by both farm size and livestock type is provided in appendix D. A breakdown by enterprise type and farm size is provided in appendix E. State estimates are provided in appendix B.

Figure 19 Manure nitrogen *as excreted*, by livestock type

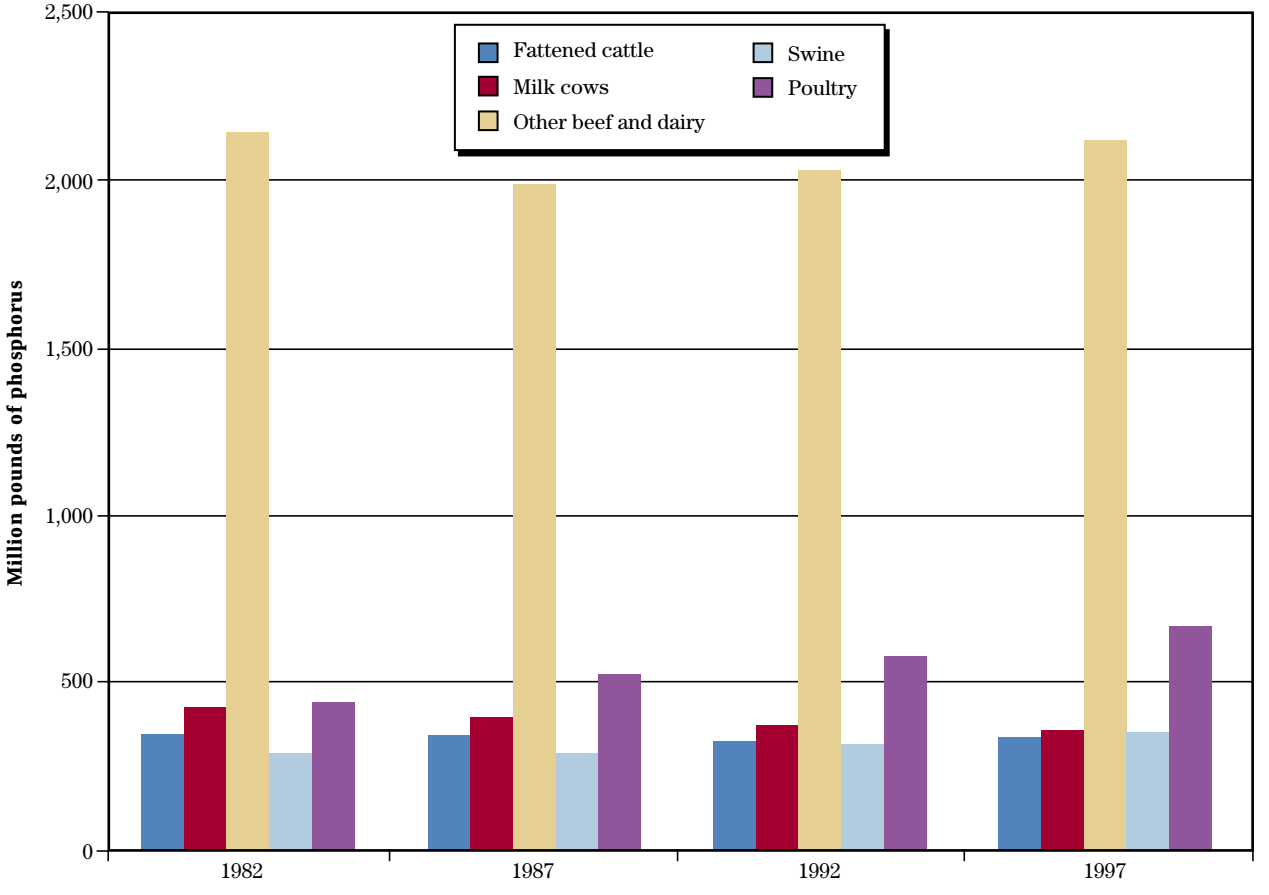


livestock production areas. Of particular concern is volatilized nitrogen in the form of ammonia and ammonium. Deposition (both wet and dry) of airborne ammonia and ammonium has been shown in some studies to occur in close proximity to the source of emission, sometimes within 100 meters and often within 10,000 meters (Asman, 1998). Treatment systems, such as lagoons and spray irrigation, release nitrogen into the air, thereby reducing nitrogen loads associated with land application, but exacerbate problems resulting from airborne deposition.

In 1997, recoverable manure nutrients amounted to 2.6 billion pounds of nitrogen and 1.4 billion pounds of phosphorus, representing increases of 17 percent and 19 percent over 1982 amounts, respectively (tables 10 and 11). These rates of increase exceed increases for total manure nutrients produced because of two factors: the increase in the proportion of confined livestock and the increased share of poultry in the livestock mix.

Poultry had the largest share of recoverable manure nutrients—45 percent of the nitrogen and 38 percent of the phosphorus in 1997 (table 12). The poultry share increased 10 percentage points from 1982 to 1997 for nitrogen and 8 percentage points for phosphorus. Overall, recoverable manure nutrients from poultry increased 52 percent between 1982 and 1997 for both nitrogen and phosphorus (figs. 21 and 22, tables 10 and 11). Swine also showed a large increase in recoverable nutrients from 1982 to 1997; recoverable nitrogen increased 36 percent and recoverable phosphorus increased 35 percent. In 1997, swine accounted for

Figure 20 Manure phosphorus as excreted, by livestock type



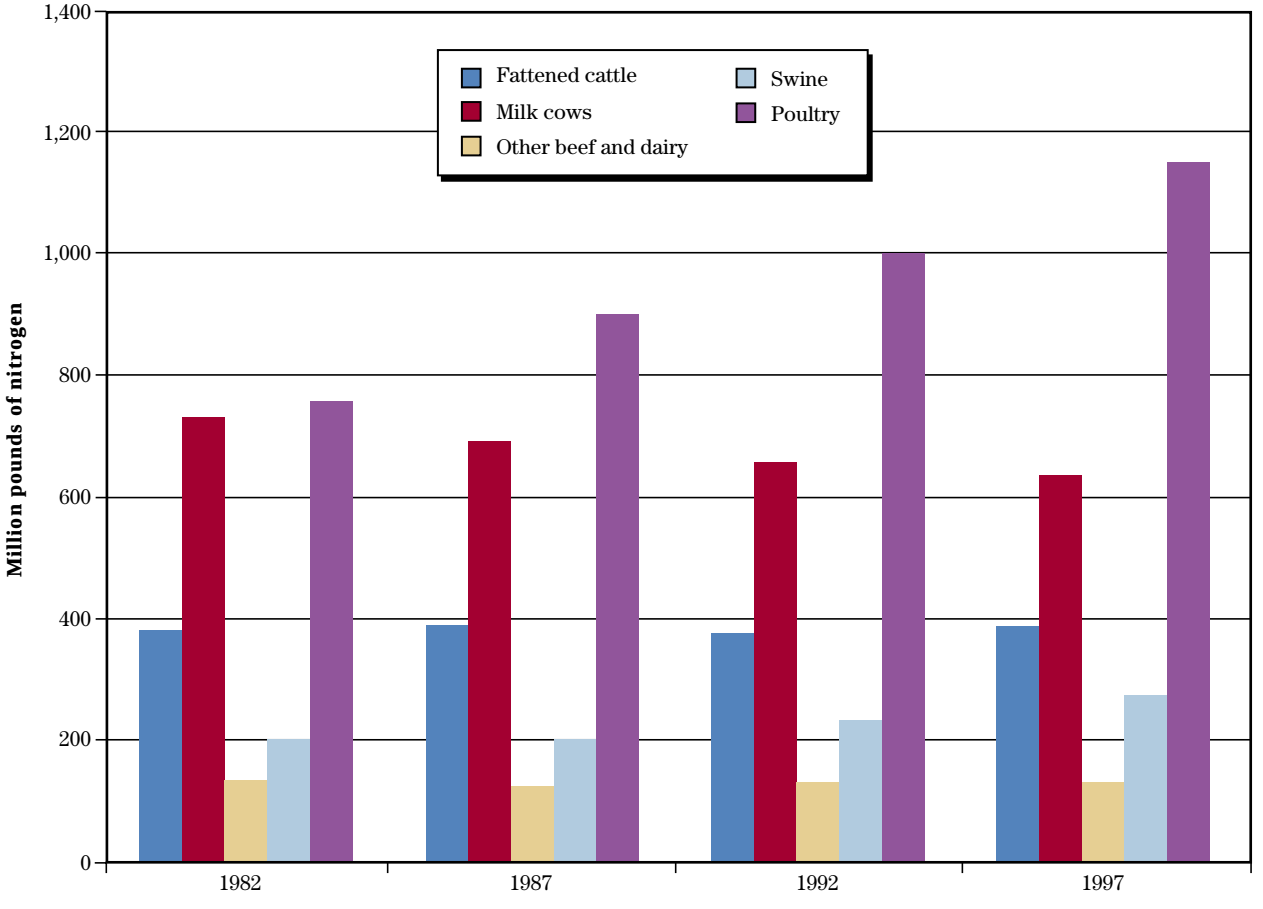
about 11 percent of the recoverable nitrogen and 19 percent of the recoverable phosphorus. Milk cows accounted for about 25 percent of the nitrogen in 1997 and about 17 percent of the phosphorus. Milk cow shares in 1997 were lower than in 1982 as a result of a 13 percent decrease in recoverable nitrogen and phosphorus. Recoverable manure nutrients for fattened cattle changed little between 1982 and 1997, accounting for about 15 percent of the nitrogen in 1997 and about 18 percent of the phosphorus.

Following the trends in animal units described earlier, recoverable manure nutrients for large operations increased substantially between 1982 and 1997 (tables 10 and 11, figs. 23 and 24). Recoverable manure nutrients for operations with at least 1,000 animal units more than doubled, while substantial decreases occurred for operations with less than 150 animal units.

Table 12 Percent of total recoverable manure nutrients accounted for by each livestock type, 1982 and 1997

Livestock type	Recoverable nitrogen		Recoverable phosphorus	
	1982	1997	1982	1997
Fattened cattle	17.3	15.1	20.1	17.7
Milk cows	33.1	24.6	23.2	17.0
Other beef and dairy	6.1	5.1	9.2	7.5
Swine	9.2	10.6	17.0	19.3
Poultry	34.3	44.6	30.2	38.5
All types	100.0	100.0	100.0	100.0

Figure 21 Recoverable manure nitrogen (available for application), by livestock type



Potential CAFOs accounted for about half of the recoverable manure nutrients in 1997, but accounted for only 25 to 27 percent in 1982 (table 13). Most (86 percent) of the recoverable manure nutrients in 1997 for fattened cattle were associated with potential CAFOs. For swine, 57 percent of the recoverable manure nutrients were associated with potential CAFOs in 1997, up from 11 percent in 1982. About half of the recoverable manure nutrients for poultry was associated with potential CAFOs, and 22 percent of the recoverable manure nutrients for milk cows was associated with potential CAFOs in 1997, both up substantially from percentages in 1982 (table 13).

The spatial distribution of recoverable nitrogen and phosphorus is similar (maps 20 and 21) and corresponds closely to the spatial distribution for confined animal units (map 7). The spatial distribution of changes in recoverable manure nutrients (not shown here) from 1982 to 1997 also corresponded closely to changes in animal units (map 8), with the greatest increases taking place in the areas of highest production and the greatest decreases occurring in Florida, southwest Texas, Arizona, the Northeast, the Idaho-Wyoming-Montana area, and a region in the Midwest centered around Wisconsin.

Figure 22 Recoverble manure phosphorus (available for application), by livestock type

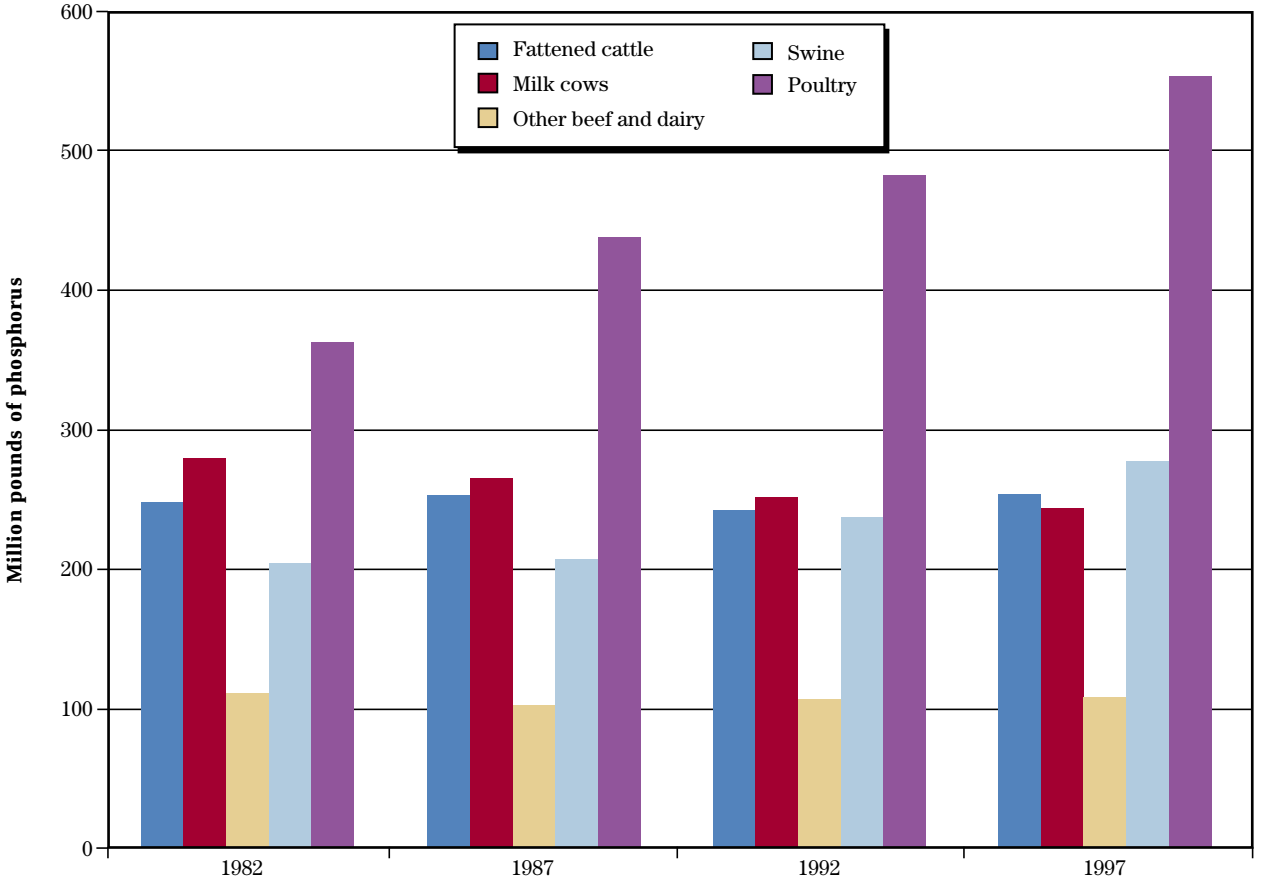
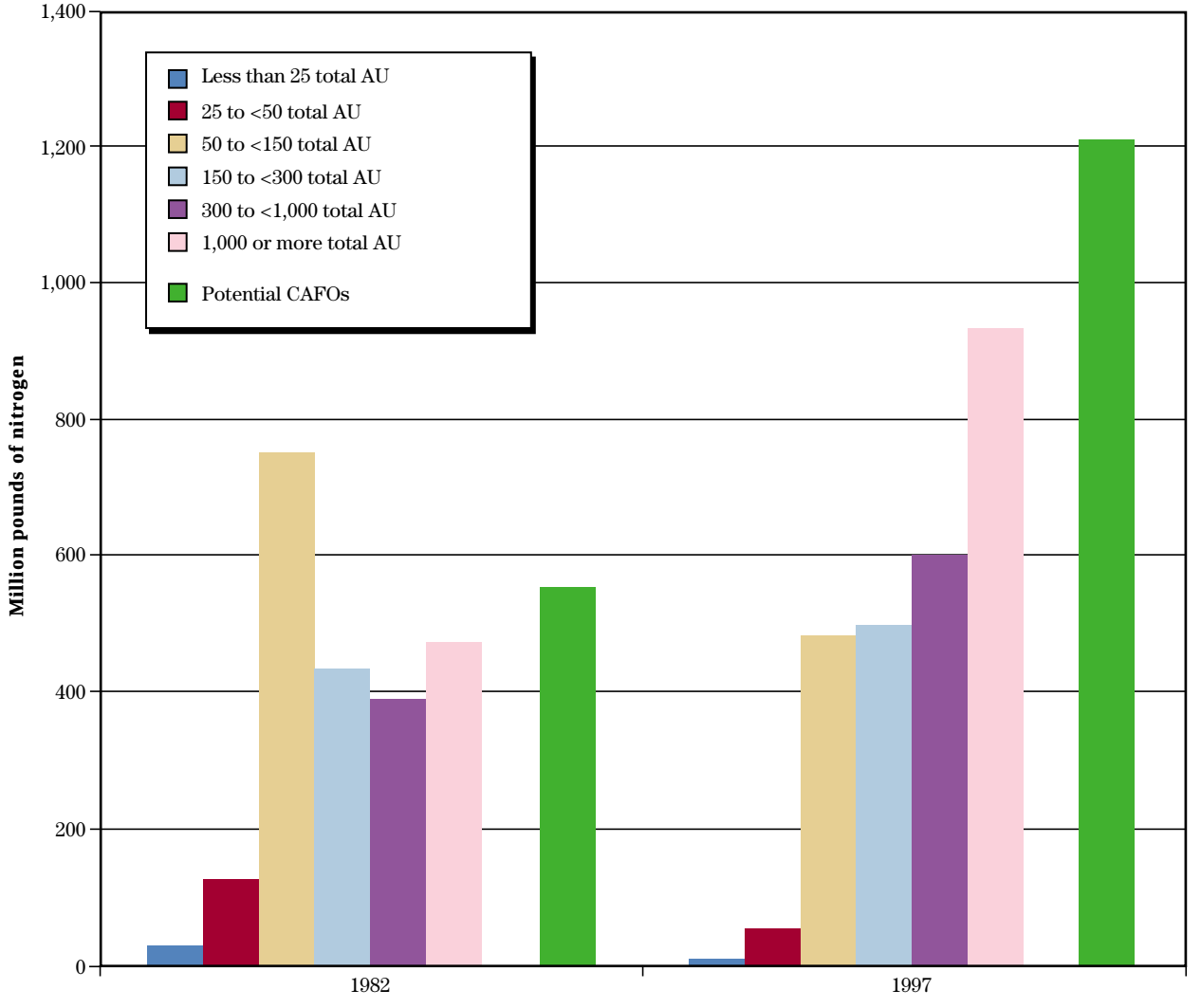
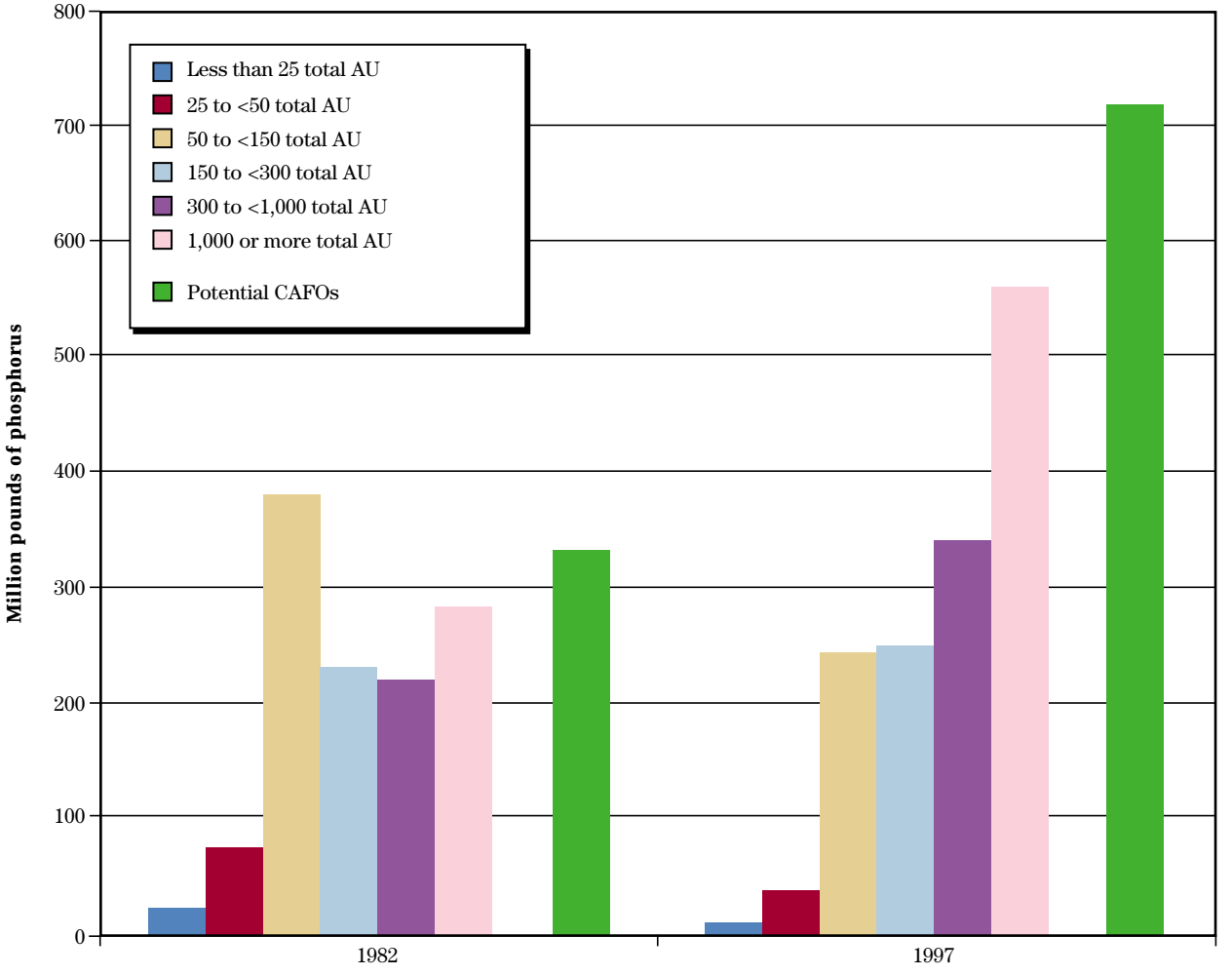


Figure 23 Recoverable manure nitrogen (available for application) by farm size, 1982 and 1997*



* Size classes are based on total animal units on farms, including both confined livestock and livestock not held in confinement.

Figure 24 Recoverable manure phosphorus (available for application) by farm size, 1982 and 1997*



* Size classes are based on total animal units on farms, including both confined livestock and livestock not held in confinement.

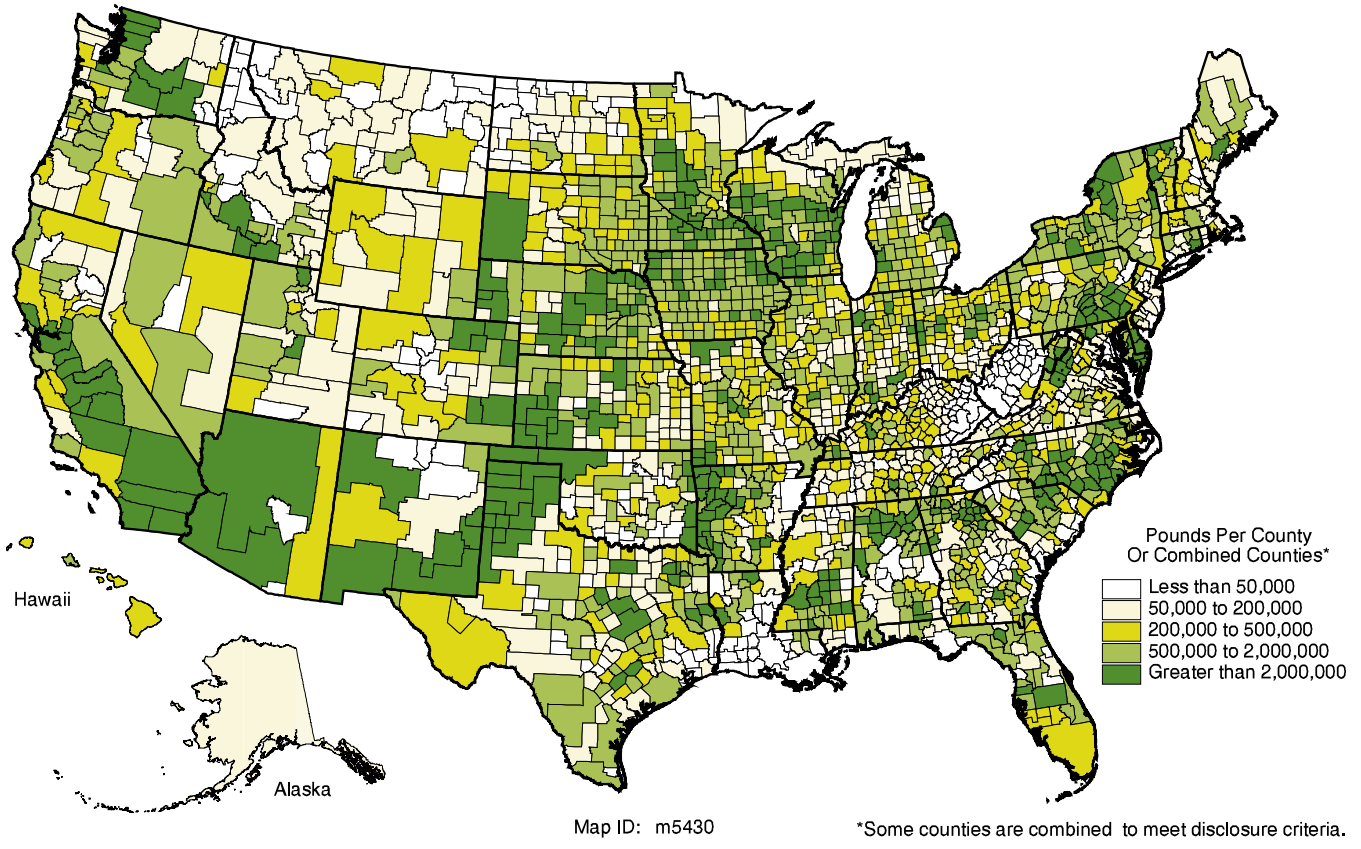
Table 13 Manure nutrients produced by all livestock (both confined and not confined) on operations identified as potential CAFOs

	1982	1987	1992	1997	Percent change 1982-1997	1982	1987	1992	1997
Manure nitrogen	Million pounds					% of total produced on all operations			
All potential CAFOs*									
As excreted	1,573.5	1,966.3	2,373.3	3,333.2	+112	13	16	19	26
Recoverable	556.3	725.8	878.7	1,210.7	+118	25	31	37	47
	Million pounds					% of amount produced by all livestock of specified type			
Potential fattened cattle CAFOs									
As excreted	754.7	825.7	836.9	934.1	+24	67	73	78	84
Recoverable	271.6	297.1	301.2	336.1	+24	71	77	81	86
Potential milk cow CAFOs									
As excreted	125.2	173.4	270.5	428.0	+242	5	8	13	21
Recoverable	36.9	52.8	84.2	136.8	+271	5	8	13	22
Potential swine CAFOs									
As excreted	96.4	142.1	265.2	660.8	+586	10	15	25	55
Recoverable	22.9	33.7	62.9	156.8	+586	11	16	27	57
Potential poultry CAFOs									
As excreted	359.7	554.7	700.0	943.1	+162	28	36	41	48
Recoverable	214.7	329.0	413.5	556.5	+159	28	37	41	48
Manure phosphorus	Million pounds					% of total produced on all operations			
All potential CAFOs*									
As excreted	482.8	605.7	717.7	990.8	+105	13	17	20	26
Recoverable	331.2	424.4	509.8	717.4	+117	27	34	39	50
	Million pounds					% of amount produced by all livestock of specified type			
Potential fattened cattle CAFOs									
As excreted	231.6	253.4	256.9	286.7	+24	67	73	78	84
Recoverable	176.9	193.6	196.2	219.0	+24	71	77	81	86
Potential milk cow CAFOs									
As excreted	22.5	31.2	48.6	76.9	+242	5	8	13	21
Recoverable	14.2	20.3	32.3	52.5	+271	5	8	13	22
Potential swine CAFOs									
As excreted	28.6	42.2	78.7	195.8	+584	10	15	25	55
Recoverable	23.1	34.1	63.6	158.2	+584	11	16	27	57
Potential poultry CAFOs									
As excreted	131.8	201.0	248.1	326.7	+148	30	38	43	49
Recoverable	109.8	167.5	206.7	272.1	+148	30	38	43	49

* The sum over livestock types will be less than the total for all CAFOs because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO, including other beef and dairy.

Notes: Pounds of manure nutrients by livestock type are for the specified animal type only and do not include manure nutrients from other animal types on the farms.
Values taken from appendix D, tables D–1, D–3, D–4, and D–6.

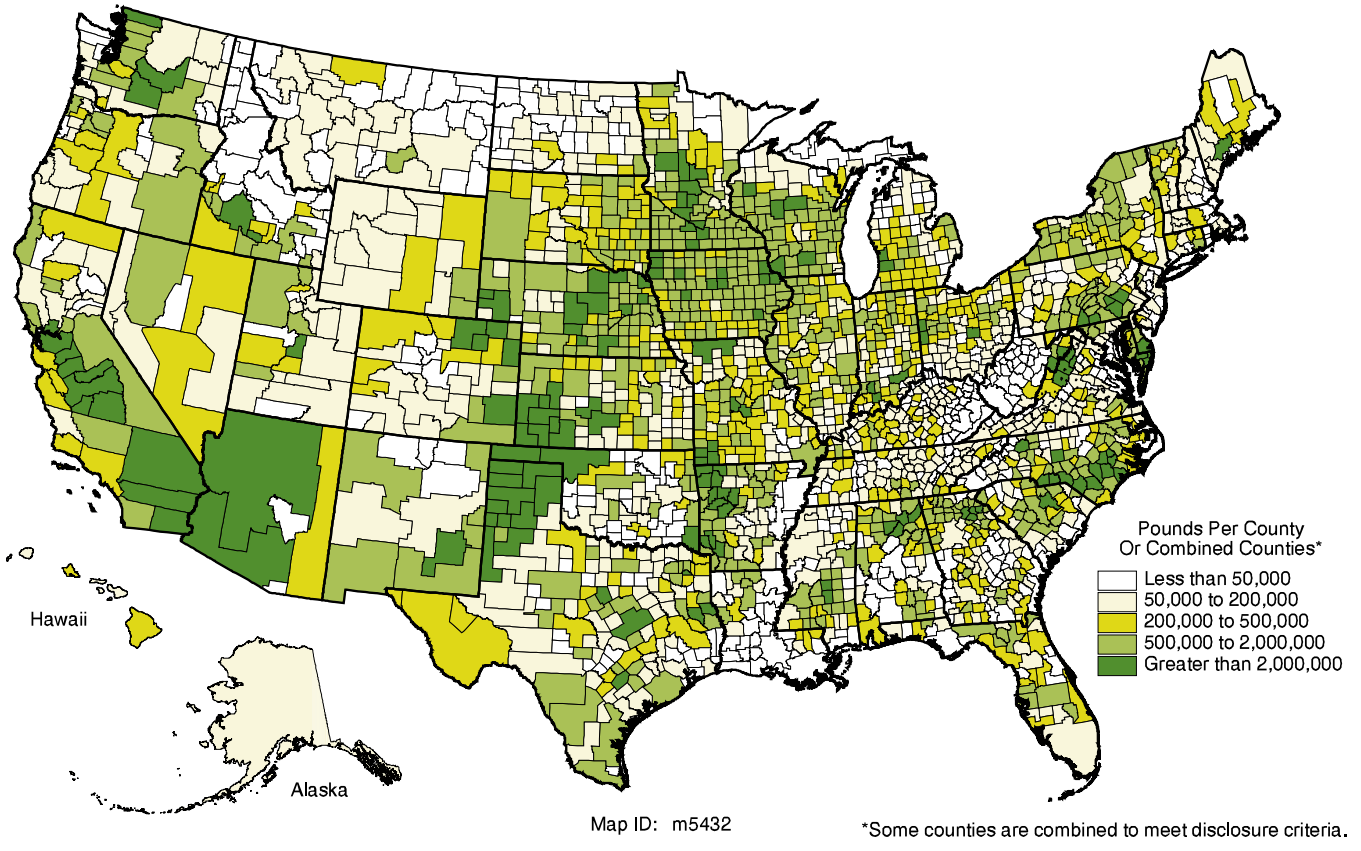
Map 20 Manure nitrogen available for application (recoverable from confined livestock), 1997



Map ID: m5430

*Some counties are combined to meet disclosure criteria.

Map 21 Manure phosphorus available for application (recoverable from confined livestock), 1997



Map ID: m5432

*Some counties are combined to meet disclosure criteria.

Land available for manure application

Land available for manure application fluctuates from year to year, reflecting changes in cropping patterns and land use. For this analysis, cropland consisting of 24 crops, cropland used as pasture, and half of the permanent pasture comprises the land available for manure application. The 24 crops comprise the bulk of the cropland acreage in most counties. In 1997, these 24 crops and cropland used as pasture accounted for 85 percent of the total cropland on all farms and 90 percent of the cropland on livestock operations. Using this measure, the total amount of land available for manure application in the U.S. fluctuated between 312 million acres and 390 million acres between 1982 and 1997. Of this, about half was available on livestock operations with confined animals (table 14). About half the cropland not included in land available for manure application is categorized as either idle cropland or cropland in cultivated summer fallow.

Acres of 24 crops and pastureland

	1982	1987	1992	1997
Acres on all farms, millions	339.6	311.5	381.8	390.0
Acres on livestock operations, millions	237.4	212.1	241.7	236.8
Operations with confined animals				
Acres, millions	182.5	162.1	153.7	176.5
Percent of acres on all farms	54	52	48	45

Table 14 Million acres of farmland available for manure application on livestock operations with confined animals, 1982–1997

Livestock type and farm size category	1982			1987			1992			1997		
	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre
All livestock operations*												
Less than 25 total AU	10.698	2.983	0.04	8.889	2.968	0.04	8.682	2.406	0.04	7.055	2.221	0.02
25 to <50 total AU	20.187	10.262	0.06	17.049	9.978	0.06	19.181	9.830	0.05	17.747	9.252	0.03
50 to <150 total AU	53.970	22.161	0.15	44.869	21.150	0.15	51.274	21.168	0.12	45.899	19.409	0.10
150 to <300 total AU	23.928	9.348	0.21	21.117	9.358	0.22	26.664	10.069	0.18	26.355	9.637	0.17
300 to <1,000 total AU	14.758	7.012	0.28	13.378	6.982	0.32	18.622	7.870	0.27	21.131	8.341	0.28
1,000 or more total AU	4.183	3.055	1.18	3.596	2.771	1.60	4.792	3.099	1.49	6.132	3.326	1.70
All operations	127.723	54.820	0.19	108.899	53.207	0.22	129.216	54.443	0.20	124.319	52.185	0.22
Potential CAFOs	2.828	0.670	2.66	2.618	0.714	3.36	4.141	0.812	2.67	5.411	0.869	2.95
Operations with fattened cattle												
Less than 25 AU	16.175	4.018	0.03	13.355	3.562	0.03	12.823	2.899	0.03	10.222	1.951	0.02
25 to <50 AU	5.131	1.279	0.06	4.058	1.147	0.06	4.229	0.916	0.05	3.734	0.720	0.04
50 to <150 AU	5.578	1.184	0.13	4.180	1.044	0.13	4.469	0.888	0.10	3.940	0.672	0.09
150 to <300 AU	1.959	0.365	0.28	1.455	0.351	0.30	1.560	0.265	0.24	1.426	0.258	0.19
300 to <1,000 AU	1.407	0.298	0.52	1.120	0.291	0.58	1.489	0.250	0.43	1.296	0.187	0.43
1,000 or more AU	0.626	0.141	7.45	0.512	0.189	9.08	0.716	0.215	7.00	0.746	0.192	7.96
All operations	30.876	7.284	0.24	24.680	6.584	0.30	25.286	5.433	0.29	21.365	3.978	0.37
Potential CAFOs	1.790	0.387	2.98	1.464	0.431	3.75	1.992	0.419	2.98	1.841	0.359	3.65

See footnotes at bottom of table.

Table 14 Million acres of farmland available for manure application on livestock operations with confined animals, 1982–1997 —Continued

Livestock type and farm size category	1982			1987			1992			1997		
	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre	Cropland (24 crops)	Pasture-land	AU/acre
Operations with milk cows												
Less than 25 AU**	0	0	0	0	0	0	0	0	0	0	0	0
25 to <50 AU	6.865	2.024	0.20	4.627	1.478	0.21	3.743	1.109	0.19	2.471	0.717	0.18
50 to <150 AU	19.424	4.653	0.25	16.974	4.198	0.26	15.984	3.665	0.24	12.914	2.651	0.24
150 to <300 AU	3.774	0.980	0.34	3.903	1.050	0.35	4.337	1.025	0.32	4.295	0.833	0.31
300 to <1,000 AU	1.351	0.423	0.72	1.386	0.417	0.77	1.805	0.494	0.68	2.368	0.440	0.65
1,000 or more AU	0.266	0.126	1.47	0.266	0.085	2.36	0.379	0.100	2.76	0.718	0.106	2.59
All operations	31.679	8.207	0.28	27.155	7.228	0.31	26.246	6.391	0.31	22.766	4.746	0.36
Potential dairy CAFOs	0.264	0.125	1.48	0.264	0.085	2.36	0.374	0.100	2.77	0.716	0.105	2.59
Operations with other beef and dairy cattle												
Less than 25 AU	14.806	4.661	0.02	11.962	4.388	0.02	11.113	3.527	0.01	10.149	3.089	0.01
25 to <50 AU	27.920	12.393	0.03	23.264	11.931	0.03	25.074	11.640	0.02	23.101	10.566	0.02
50 to <150 AU	36.489	18.788	0.03	31.292	18.656	0.03	39.425	19.698	0.03	39.741	18.727	0.03
150 to <300 AU	11.659	6.657	0.04	10.216	6.776	0.04	14.879	7.734	0.03	17.064	8.103	0.03
300 to <1,000 AU	8.415	5.463	0.04	7.306	5.390	0.05	10.897	6.284	0.04	13.190	6.882	0.04
1,000 or more AU	2.643	2.539	0.06	2.234	2.307	0.07	2.734	2.542	0.07	3.494	2.904	0.08
All operations	101.932	50.500	0.03	86.275	49.448	0.03	104.122	51.427	0.03	106.740	50.273	0.03
Operations with swine												
Less than 25 AU	16.957	3.930	0.04	11.947	3.096	0.05	10.934	2.308	0.04	5.363	0.951	0.04
25 to <50 AU	10.063	1.638	0.10	8.171	1.495	0.10	8.629	1.258	0.08	4.814	0.567	0.07
50 to <150 AU	11.001	1.379	0.20	9.960	1.323	0.21	12.419	1.316	0.17	8.039	0.676	0.17
150 to <300 AU	2.277	0.253	0.37	2.394	0.245	0.40	3.616	0.298	0.34	3.186	0.216	0.35
300 to <1,000 AU	0.880	0.113	0.66	1.006	0.127	0.79	1.804	0.153	0.66	2.356	0.170	0.84
1,000 or more AU	0.061	0.016	2.77	0.078	0.022	3.79	0.191	0.029	3.98	0.511	0.055	5.03
All operations	41.239	7.328	0.13	33.554	6.309	0.16	37.593	5.361	0.17	24.270	2.636	0.31
Potential swine CAFOs	0.692	0.104	0.87	0.758	0.109	1.18	1.553	0.136	1.12	2.463	0.185	1.76
Operations with poultry												
Less than 25 AU	3.980	1.523	0.02	2.317	0.980	0.02	1.292	0.511	0.03	0.909	0.327	0.03
25 to <50 AU	0.485	0.266	0.47	0.353	0.212	0.49	0.334	0.159	0.40	0.311	0.145	0.37
50 to <150 AU	0.787	0.450	0.95	0.655	0.453	1.10	0.758	0.479	0.98	0.806	0.509	0.89
150 to <300 AU	0.253	0.144	1.64	0.281	0.175	1.76	0.400	0.232	1.62	0.509	0.288	1.59
300 to <1,000 AU	0.219	0.104	2.73	0.259	0.119	3.16	0.375	0.148	2.59	0.479	0.182	2.50
1,000 or more AU	0.064	0.030	8.95	0.090	0.039	9.97	0.128	0.044	8.84	0.165	0.042	8.88
All operations	5.788	2.518	0.48	3.954	1.979	0.82	3.288	1.573	1.10	3.178	1.493	1.31
Potential poultry CAFOs	0.149	0.076	5.50	0.204	0.111	5.99	0.326	0.169	4.67	0.501	0.229	4.13

* The sum of acres over livestock types will exceed the totals because many farms have more than one livestock type.

** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).

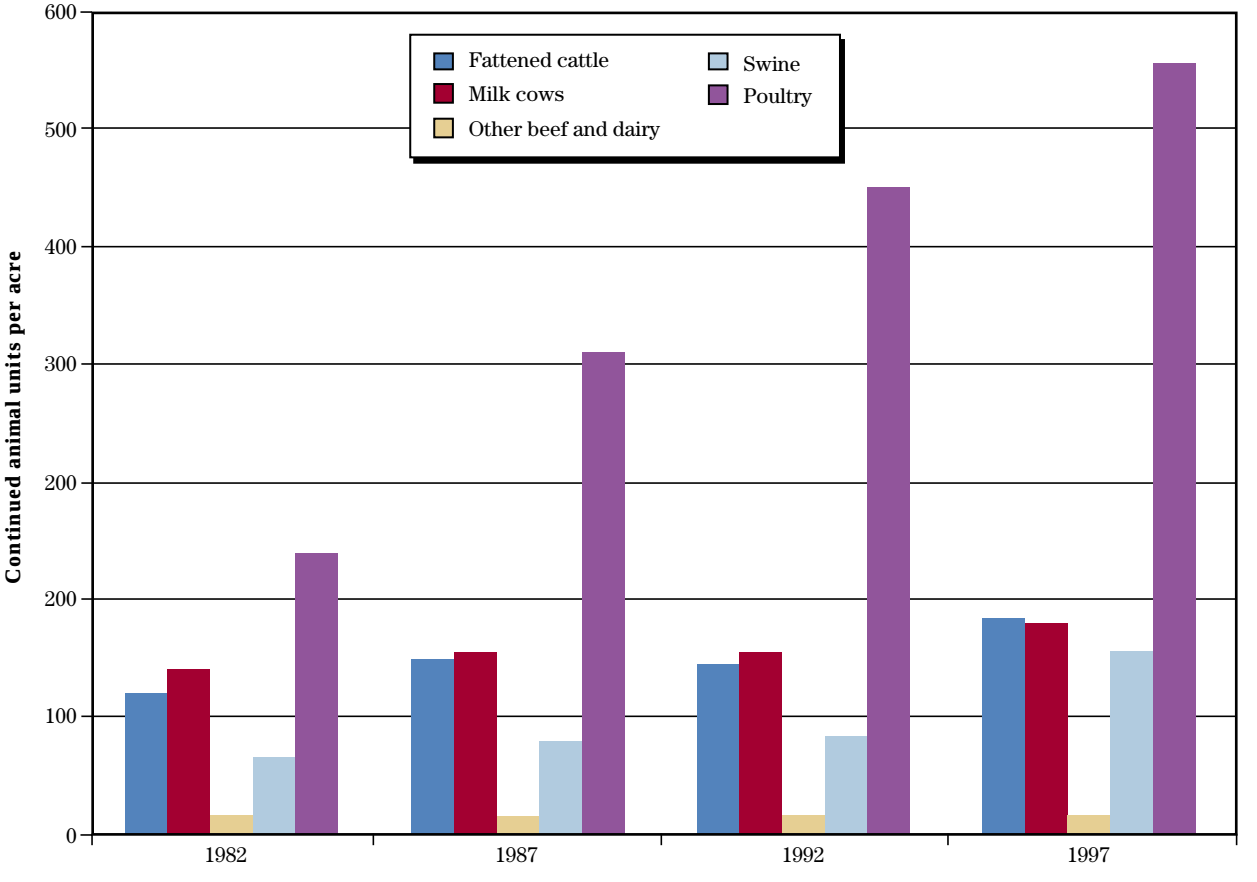
Notes: State estimates of acres are provided in appendix B.
Size classes are based on all animal units (AU) on farms and include confined animals and animals not held in confinement. Animal units per acre are for confined animal units.

The ratio of confined livestock to acres available for manure application on operations with confined livestock (confined livestock density) is a measure of *livestock pressure* in an area, and, as such, is an indicator of areas where excess manure nutrients may occur. Confined animal units per acre averaged 0.19 in 1982 and 0.22 in 1997 (table 14). Density was lowest on smaller operations for all livestock types and highest on the largest operations. In 1997, operations with at least 1,000 animal units averaged 1.7 confined animal units per acre, up from an average of 1.18 in 1982. Potential CAFOs averaged 2.95 confined animal units per acre in 1997.

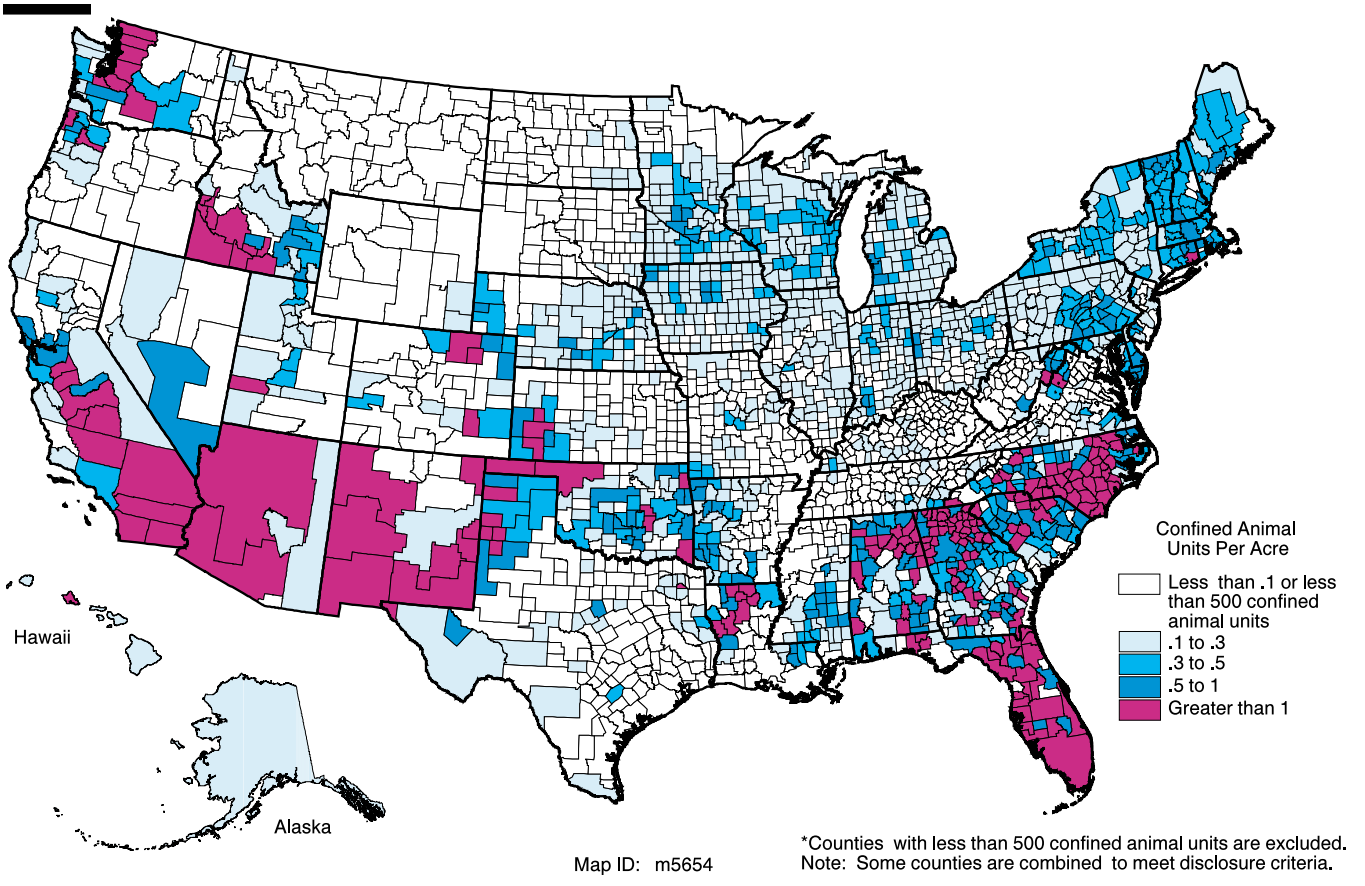
Important differences also exist among livestock types (table 14, fig. 25). Poultry had the highest densities for all four census years, and showed a dramatic increase in density between 1982 and 1997 (from 0.48 to 1.31). Densities for fattened cattle and milk cows were the next highest, increasing from 0.24 in 1982 to 0.37 in 1997 for fattened cattle and from 0.28 in 1982 to 0.36 in 1997 for milk cows. Densities for swine remained fairly constant from 1982 through 1992 at about 0.13 to 0.17 confined animal units per acre, and then increased to 0.31 in 1997. Densities for other beef and dairy were small for all years. The highest densities in 1997 were observed for poultry on operations with at least 1,000 poultry animal units (8.9 confined animal units per acre) and for fattened cattle on operations with at least 1,000 fattened cattle animal units (8.0 confined animal units per acre) (table 14).

The spatial distribution of confined livestock density is shown in map 22. Most of the production areas for livestock held in confinement in the Southeast and in the Southwest had average county densities greater than 1.0. These same areas showed increases in density of more than 0.5 confined animal units per acre between 1982 and 1997 (map 23).

Figure 25 Confined animal units per acre for operations with confined livestock



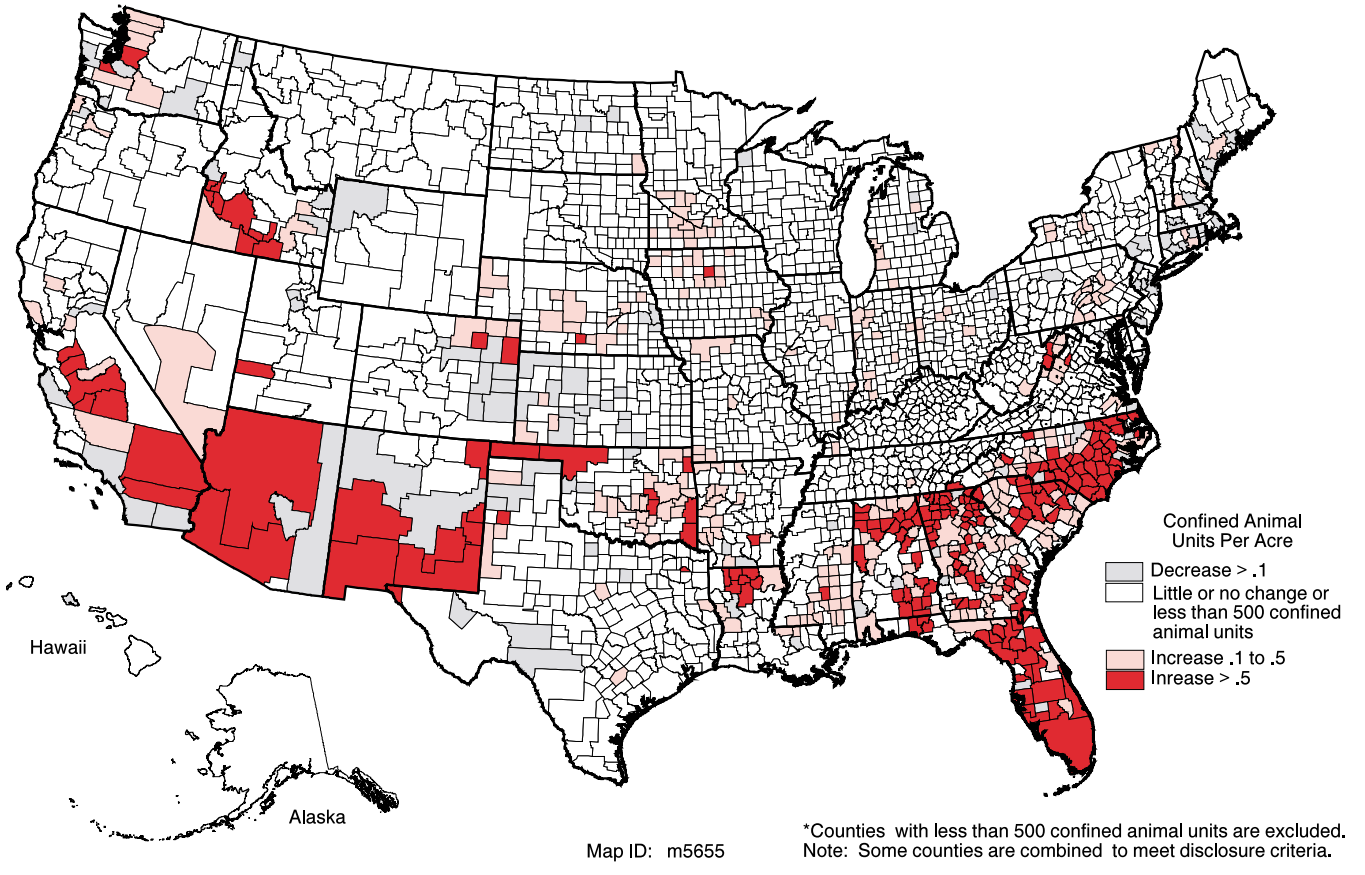
Map 22 Confined animal units per acre for operations with confined livestock, 1997



Map ID: m5654

*Counties with less than 500 confined animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

Map 23 Change in confined animal units per acre for operations with confined livestock from 1982 to 1997



Map ID: m5655

*Counties with less than 500 confined animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

About 6 percent of the livestock operations with confined animals in 1997—31,474 operations—had no acres available for manure application, as measured here (table 15). These farms would be expected to apply manure on surrounding properties. About half were operations with less than 50 animal units. A significant number of large operations also did not have any acres of the 24 crops or pastureland; of the 11,242 potential CAFOs in 1997, for example, 2,603 (about a fourth) had none of these acres. Of these potential CAFOs without acres available for manure application, poultry operations comprised 41 percent and swine operations comprised 38 percent in 1997. The percentage for poultry was similar for the earlier years, but the percentage for swine was much lower in 1982, 1987, and 1992. (The poultry industry has traditionally exported manure to surrounding properties.)

Table 15 Number of confined livestock operations with none of the 24 crops and no pastureland, 1982–1997*

Livestock type and farm size category	1982	1987	1992	1997
All confined livestock operations				
Less than 25 total AU	15,258	13,956	10,833	6,111
25 to <50 total AU	12,858	12,903	10,338	8,110
50 to <150 total AU	12,363	13,767	12,183	9,771
150 to <300 total AU	2,852	3,474	3,527	3,362
300 to <1,000 total AU	1,905	2,352	2,575	2,764
1,000 or more total AU	642	818	1,063	1,356
All operations	45,878	47,270	40,519	31,474
Potential CAFOs	1,032	1,439	1,928	2,603
Livestock operations with fattened cattle				
Less than 25 AU	2,131	2,284	1,580	803
25 to <50 AU	384	443	285	144
50 to <150 AU	338	427	235	154
150 to <300 AU	88	134	92	65
300 to <1,000 AU	97	122	98	76
1,000 or more AU	221	243	240	219
All operations	3,259	3,653	2,530	1,461
Potential CAFOs	305	350	331	290
Livestock operations with milk cows				
Less than 25 milk cow AU**	0	0	0	0
25 to <50 AU	1,229	1,255	619	378
50 to <150 AU	1,097	1,220	854	570
150 to <300 AU	229	253	198	152
300 to <1,000 AU	310	308	359	344
1,000 or more AU	55	97	221	266
All operations	2,920	3,133	2,251	1,710
Potential CAFOs	53	95	216	263
Livestock operations with other beef and dairy cattle				
Less than 25 AU	4,795	5,101	3,873	3,234
25 to <50 AU	7,508	8,076	6,538	6,080
50 to <150 AU	5,255	6,040	5,362	4,822
150 to <300 AU	1,167	1,434	1,329	1,108
300 to <1,000 AU	684	821	886	851
1,000 or more AU	233	262	287	304
All operations	19,642	21,734	18,275	16,399
Livestock operations with swine				
Less than 25 AU	9,143	8,624	6,706	2,402
25 to <50 AU	2,305	2,520	2,322	1,005
50 to <150 AU	1,840	2,103	2,123	1,342
150 to <300 AU	493	572	683	672
300 to <1,000 AU	300	443	599	802
1,000 or more AU	34	61	130	352
All operations	14,115	14,323	12,563	6,575
Potential CAFOs	234	340	577	988
Livestock operations with poultry				
Less than 25 AU	4,228	2,884	1,701	1,245
25 to <50 AU	2,666	2,241	1,716	1,270
50 to <150 AU	3,660	3,918	3,841	3,253
150 to <300 AU	845	1,049	1,301	1,461
300 to <1,000 AU	536	691	801	924
1,000 or more AU	157	229	266	299
All operations	12,092	11,012	9,626	8,452
Potential CAFOs	440	656	808	1,068

* The sum over livestock types will exceed the total because many farms have more than one livestock type.
** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20 (see table 2), which converts to more than 25 milk cow animal units.

Assimilative capacity of the land

The capacity of cropland and pastureland to assimilate nutrients was estimated to be the amount of nutrients taken up and removed at harvest for cropland and the amount that could generally be applied to pastureland without accumulating nutrients in the soil. The assimilative capacity estimates for cropland, however, vary from area to area and among the four census years because of variability in yields and acres harvested. Yields vary because of weather, differences in the productivity of the strains of crops grown, the amount of nutrients applied (including commercial fertilizer), and general farming practices (including irrigation). Consequently, assimilative capacity should not be considered fixed. During times of drought, for example, the estimate of assimilative capacity for acres without irrigation would be less than the long-term potential assimilative capacity for the affected area. (Enhancement of the assimilative capacity in an area could be used as a management tool to reduce the production of excess manure nutrients. For example, assimilative capacity can be increased in some areas by adopting irrigation practices or by adjusting the mix of crops to favor crops with high nitrogen or phosphorus uptake and removal at harvest.)

The assimilative capacity for nitrogen has fluctuated between 33.5 billion and 42.5 billion pounds over the four census years (table 16). The assimilative capacity for phosphorus, however, is much lower, ranging from 5.4 to 6.6 billion pounds. These levels greatly exceed the amount of recoverable manure nitrogen and phosphorus generated, more so for nitrogen than for phosphorus. Farms with confined livestock had less than half the Nation's assimilative capacity—18.9 billion pounds of nitrogen and 3.3 billion pounds of phosphorus in 1997 (table 16). Recoverable manure nutrients produced in all years were substantially lower than the overall assimilative capacity for confined livestock

Table 16 Capacity of the land to assimilate nutrients, 1982-1997

	1982	1987	1992	1997
	million pounds			
Assimilative capacity for nitrogen				
All farms				
Cropland	30,245	27,935	34,922	36,987
Pastureland	5,601	5,595	5,719	5,533
Total	35,846	33,529	40,641	42,520
Livestock farms				
Cropland	18,872	16,559	18,977	18,834
Pastureland	4,962	4,870	4,954	4,806
Total	23,834	21,428	23,931	23,640
Livestock farms with confined animals				
Cropland	15,929	14,115	16,021	15,725
Pastureland	3,349	3,259	3,360	3,202
Total	19,278	17,375	19,380	18,927
Assimilative capacity for phosphorus				
All farms				
Cropland	3,434	3,191	4,078	4,362
Pastureland	2,235	2,233	2,283	2,208
Total	5,670	5,423	6,361	6,571
Livestock farms				
Cropland	2,291	2,030	2,377	2,451
Pastureland	1,980	1,943	1,977	1,918
Total	4,271	3,973	4,354	4,370
Livestock farms with confined animals				
Cropland	1,894	1,682	1,951	1,975
Pastureland	1,336	1,301	1,341	1,278
Total	3,231	2,982	3,291	3,253

Note: State estimates are provided in appendix B.

Assimilative capacity compared to recoverable manure nutrients, 1997 (in billion pounds)

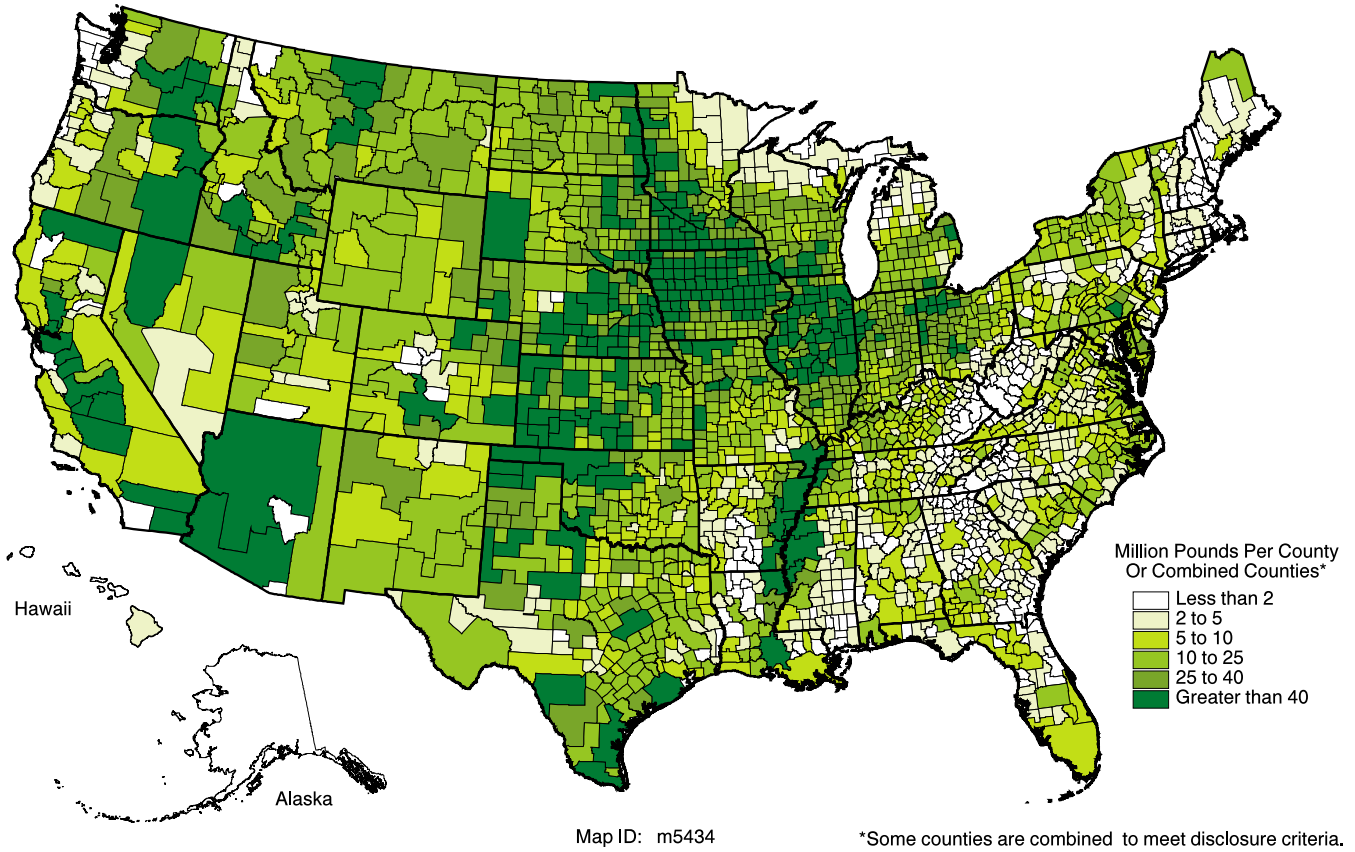
	Assimilative capacity - all farms	Assimilative capacity - confined livestock operations	Recoverable manure nutrients
Nitrogen	42.520	18.927	2.583
Phosphorus	6.571	3.253	1.437

operations. Consequently, if livestock were produced in areas proportionate to the assimilative capacity of the land, there would be no excess manure nutrients.

The spatial distributions of the capacity of cropland and pastureland on all farms to assimilate manure nitrogen and phosphorus are shown in maps 24 and 25 for 1997. As mentioned earlier, all maps have a certain amount of spatial bias because of the variability in county size. This spatial bias is especially apparent in map 25 (less so in map 24). Most of the counties with an assimilative capacity of more than 10 million pounds of phosphorus (darkest color) are combined counties, and so are larger than other counties and have greater values. Map 27 shows, however, that most of these counties are not different from nearby counties in terms of per-acre assimilative capacity. While these counties may have a large number of acres, and therefore a large assimilative capacity, the relative magnitude is exaggerated to some extent in map 25.

Most counties can assimilate at least 2 million pounds of manure nitrogen and 0.5 million pounds of manure phosphorus. Some counties in the Midwest, central Great Plains, Mississippi embayment, and irrigated areas in the West can assimilate over 40 million pounds of nitrogen and 5 million pounds of phosphorus. (The potential environmental sensitivity of any of the areas depicted as having high assimilative capacity would need to be considered in judging their suitability for increased animal production as well as other sources of nitrogen and phosphorus (commercial fertilizer). The analysis in this study did not consider environmental sensitivity.)

Map 24 Capacity of cropland and pastureland to assimilate manure nitrogen, 1997



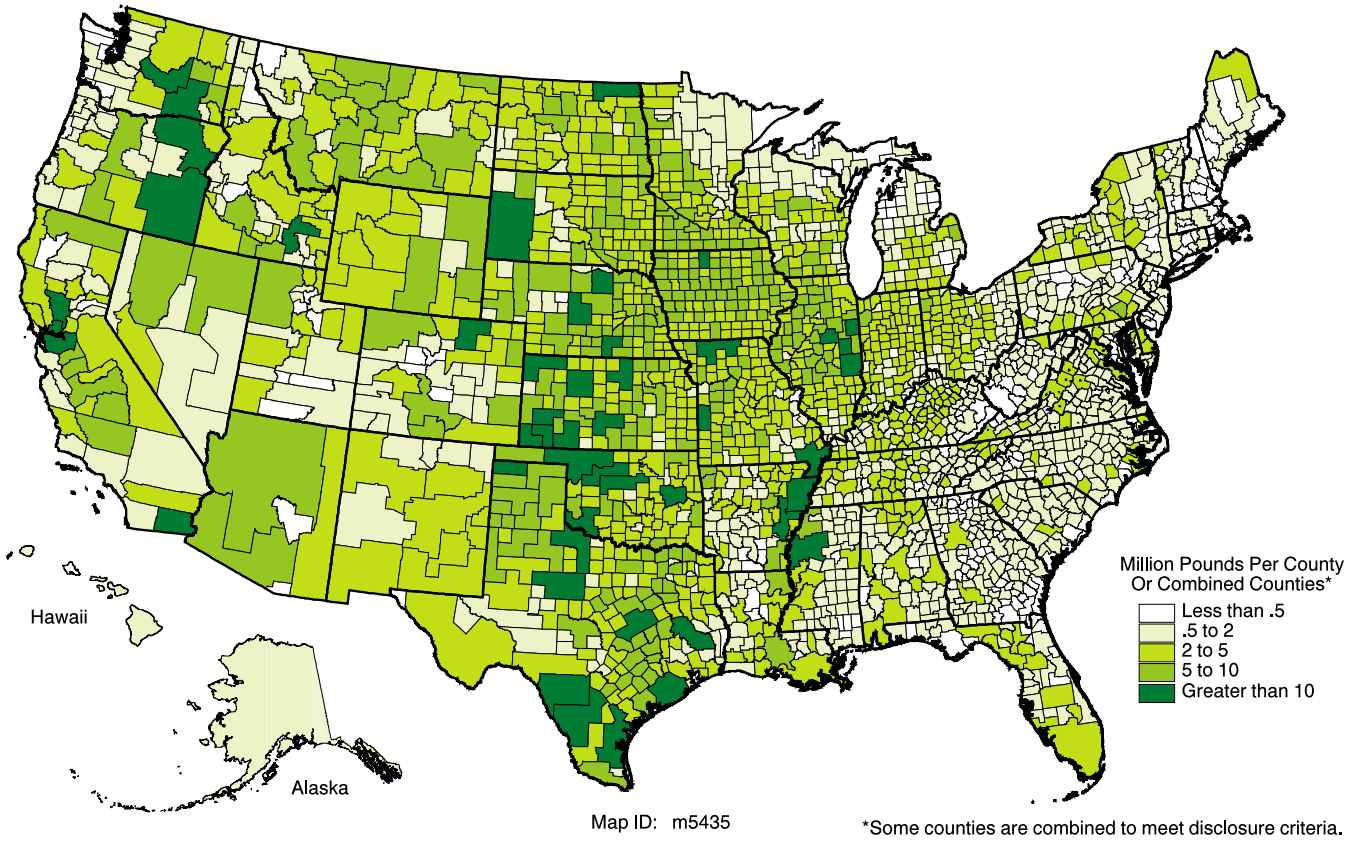
Map ID: m5434

*Some counties are combined to meet disclosure criteria.

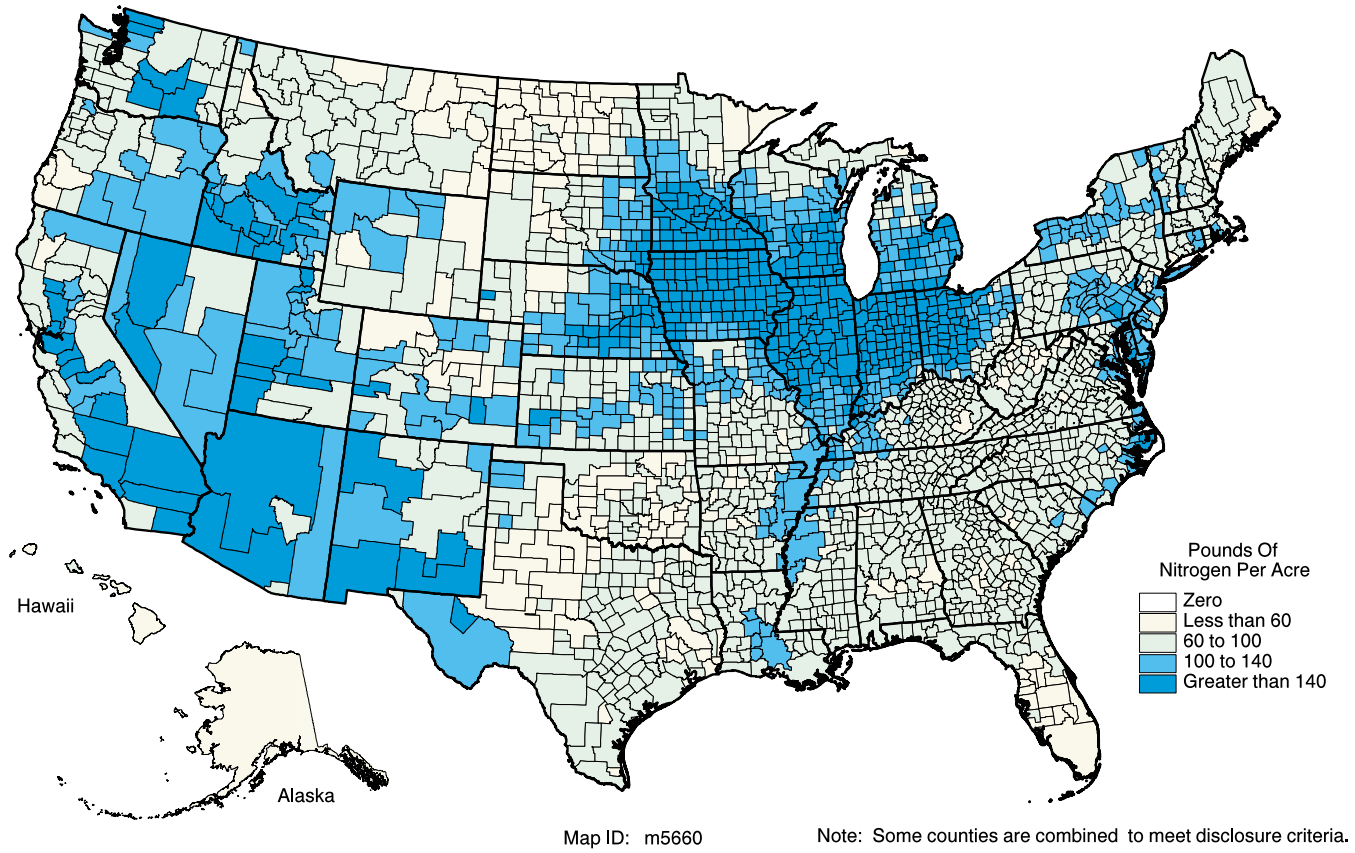
Many areas with high assimilative capacity correspond to areas with large livestock populations, but significant livestock production takes place in areas with only modest capacity to assimilate nutrients, especially in the Southeast. Regions of highest assimilative capacity per acre for nitrogen are in the Midwest (corn belt) and irrigated areas in the West (map 26). For phosphorus, regions of highest per-acre assimilative capacity correspond to areas with significant pastureland acreage (map 27). Some of these areas with high assimilative capacity per acre have few acres of cropland and pastureland, so overall assimilative capacity in these areas is small. The average assimilative capacity for all farms ranged from 106 to 109 pounds per acre for nitrogen over the four census years and was 17 pounds per acre for phosphorus. The average assimilative capacity for livestock operations only was slightly higher—111 pounds per acre for nitrogen and 21 pounds per acre for phosphorus in 1997.

	Average assimilative capacity, pounds per acre			
	1982	1987	1992	1997
Nitrogen	106	108	107	109
Phosphorus	17	17	17	17

Map 25 Capacity of cropland and pastureland to assimilate manure phosphorus, 1997



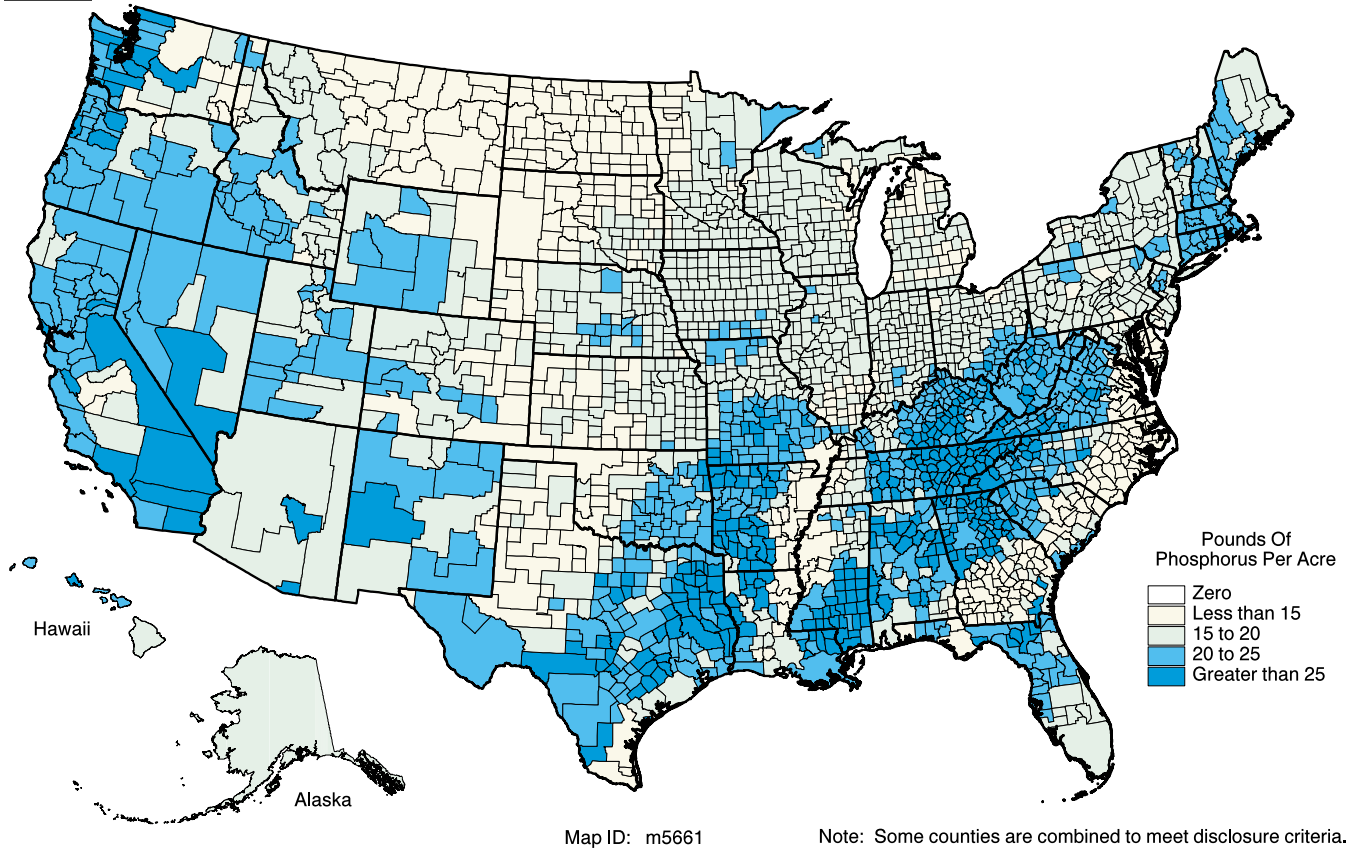
Map 26 Assimilative capacity for nitrogen, pounds per acre, 1997



Map ID: m5660

Note: Some counties are combined to meet disclosure criteria.

Map 27 Assimilative capacity for phosphorus, pounds per acre, 1997



Map ID: m5661

Note: Some counties are combined to meet disclosure criteria.

Farm-level excess manure nutrients

Farm-level excess manure nutrients measure the imbalance between assimilative capacity and the quantity of manure nutrients produced on the farm. The concept of excess manure nutrients is limited to the use of manure for land application. This excess could also be viewed as a surplus, and thus a source of raw materials for manure nutrient processing and distribution industries. The concentration of manure nutrients in major production areas would be an advantage to such industries. Mark Jenner (personal communication, American Farm Bureau Federation) notes two examples already in practice: West Virginia sends turkey litter to Ohio for mushroom production, and 100,000 tons of poultry litter are exported from Arkansas to rice growing areas in the delta region each year.

Because farm-level excess nutrients can be dissipated by exporting manure to surrounding properties, which is a common practice in many areas, farm-level excess nutrients represent an upper bound on excess manure nutrients within a region. Alternatively, estimates of excess manure nutrients at the farm level provide a measure of the off-farm export requirements in a region.

In 1997, 1.5 billion pounds of farm-level excess manure nitrogen and 0.9 billion pounds of farm-level excess manure phosphorus were produced (table 17). These excess nutrients represented about 60 percent of the manure nitrogen and 65 percent of the manure phosphorus available for application (recoverable manure). Although the levels of excess manure nitrogen exceeded levels of excess manure phosphorus, more

Table 17 Farm-level excess nutrients according to farm size, 1982-1997*

	1982		1987		1992		1997		Percent change in excess nutrients 1982 to 1997
	Operations with farm-level excess nutrients	Million pounds of excess nutrients	Operations with farm-level excess nutrients	Million pounds of excess nutrients	Operations with farm-level excess nutrients	Million pounds of excess nutrients	Operations with farm-level excess nutrients	Million pounds of excess nutrients	
Manure nitrogen— Operations with									
Less than 25 total AU	19,453	11.5	17,557	9.8	14,138	6.3	7,943	3.9	–66
25 to <50 total AU	19,962	45.1	19,026	38.8	15,740	28.2	12,419	21.0	–53
50 to <150 total AU	28,149	200.5	28,674	213.8	26,184	202.5	22,332	184.1	–8
150 to <300 total AU	8,351	125.3	9,496	157.5	10,216	194.8	10,956	238.2	+90
300 to <1,000 total AU	5,470	161.6	6,580	214.5	7,202	244.1	8,552	308.9	+91
≥1,000 total AU	1,770	355.0	2,253	478.3	2,631	548.2	3,549	716.7	+102
All livestock operations	83,155	898.9	83,586	1,112.7	76,111	1,224.0	65,751	1,472.7	+64
Potential CAFOs	2,598	419.0	3,595	580.1	4,891	689.4	7,483	941.7	+125
Manure phosphorus— Operations with									
Less than 25 total AU	24,504	7.5	21,916	6.5	17,459	4.7	9,460	2.5	–66
25 to <50 total AU	26,619	24.7	24,580	21.3	20,282	16.1	15,239	11.2	–55
50 to <150 total AU	45,582	108.7	44,459	112.3	39,957	104.9	31,473	91.8	–16
150 to <300 total AU	14,623	77.1	15,627	90.6	15,870	106.0	15,492	121.6	+58
300 to <1,000 total AU	9,317	112.1	10,425	142.9	10,937	161.6	12,585	206.7	+84
≥1,000 total AU	2,603	243.2	3,203	315.5	3,638	362.3	4,779	495.4	+104
All livestock operations	123,248	573.3	120,210	689.2	108,143	755.6	89,028	929.1	+62
Potential CAFOs	4,049	284.3	5,165	375.4	6,524	442.3	9,813	626.5	+120

* Size classes are based on total animal units on farms and include both confined livestock and livestock not held in confinement.
Note: A breakdown by enterprise type and farm size is provided in appendix E. State estimates are provided in appendix B.

operations had excess manure phosphorus than had excess manure nitrogen. Following national trends of decreasing numbers of operations, the number of operations with excess manure nutrients steadily decreased between 1982 and 1997 (fig. 26, table 17). In contrast, the amount of farm-level excess manure nutrients has steadily increased (fig. 27). Overall, excess farm-level nutrients have increased over 60 percent for both phosphorus and nitrogen between 1982 and 1997 (table 17). As a result of the decreasing number of operations and the increasing production of excess manure nutrients, the average amount of excess nutrients produced per farm with excess manure more than doubled for both nitrogen and phosphorus (fig. 28). These estimates indicate that off-farm export requirements have increased dramatically as animal agriculture has become more concentrated in fewer areas and on larger operations.

The spatial distribution of farm-level excess manure nitrogen for 1997 is shown in map 28. Most areas with moderate to high numbers of confined livestock have at least some amount of farm-level excess nitrogen. Regions with the greatest amounts are generally in livestock production areas in the southern tier of states. Areas of increasing amounts of farm-level excess nitrogen (map 29) correspond closely to areas of increasing confined animal units (map 8). A few small regions (predominantly Florida, southeast Texas, and counties along the California coast) showed significant decreases in farm-level excess manure nitrogen between 1982 and 1997. The spatial distribution of farm-level excess manure phosphorus and changes between 1982 and 1997 (maps 30 and 31) were nearly identical to those for nitrogen.

In 1997, 65,751 operations had farm-level excess nitrogen and 89,028 operations had farm-level excess phosphorus (table 17). Most of these operations are clustered within the major livestock producing areas (maps 32 and 33). The number of operations in the Midwest and central Great Plains with excess manure nutrients is substantially higher for phosphorus than for nitrogen. In the other areas, the number of operations is about the same for nitrogen and phosphorus. Operations with farm-level excess nutrients and no acres of land available for manure application (none of the 24 crops or pastureland) totaled 31,474. This is about half of the operations with excess nitrogen and a third of the operations with excess phosphorus.

Operations of all sizes had excess manure nutrients in 1982, but most excess nutrients were associated with the larger operations by 1997 (table 17). For example, potential CAFOs accounted for 64 percent of the farm-level excess nitrogen and 67 percent of the farm-level excess phosphorus in 1997, compared to 47 percent of the excess nitrogen and 50 percent of the excess phosphorus in 1982. Excess nutrients on operations with less than 150 animal units decreased between 1982 and 1997, reflecting the loss of small operations.

Farms with poultry accounted for about two-thirds of the farm-level excess nitrogen and over half of the farm-level excess phosphorus in each of the four census years (table 18). Of the 1.5 billion pounds of excess nitrogen and the 0.9 billion pounds of excess phosphorus produced in 1997, 0.97 billion pounds of excess nitrogen and 0.50 billion pounds of excess phosphorus were produced on farms with poultry. Some of this excess nitrogen came from other livestock types on those operations. However, when excess nitrogen was calculated only for poultry (ignoring recoverable manure nitrogen from other livestock types), similar estimates were obtained (table 18), indicating that little of the excess was attributable to other livestock types. The second-most significant source of farm-level excess nutrients in 1997 was fattened cattle, accounting for about 20 percent of both excess nitrogen and excess phosphorus.

Figure 26 Number of operations with farm-level excess nutrients

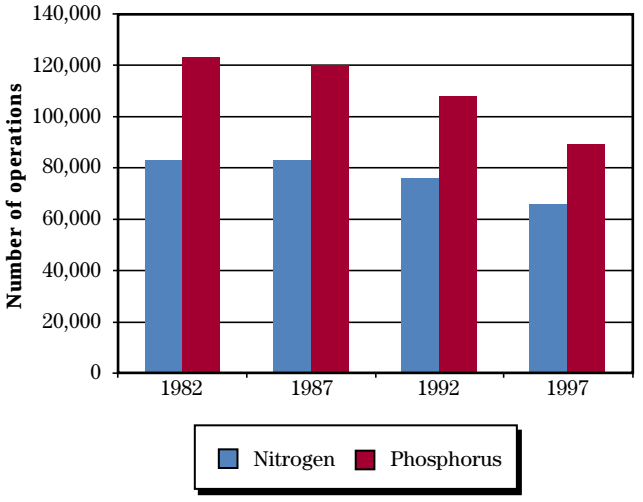


Figure 27 Million pounds of farm-level excess nutrients

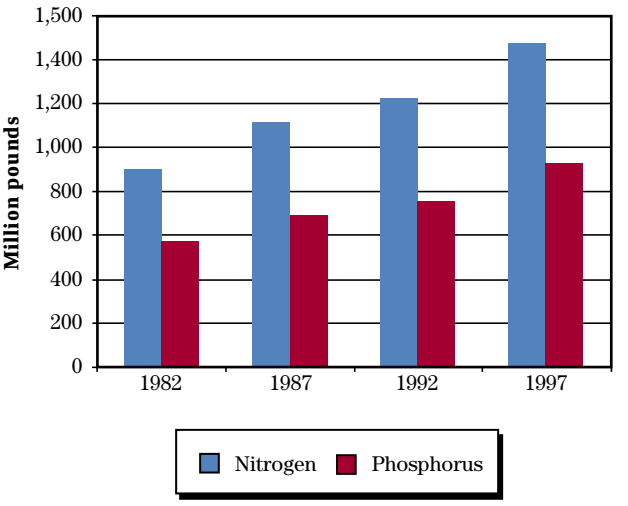
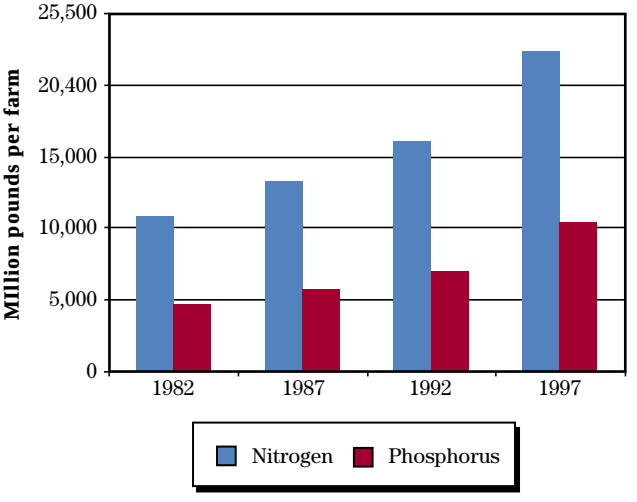
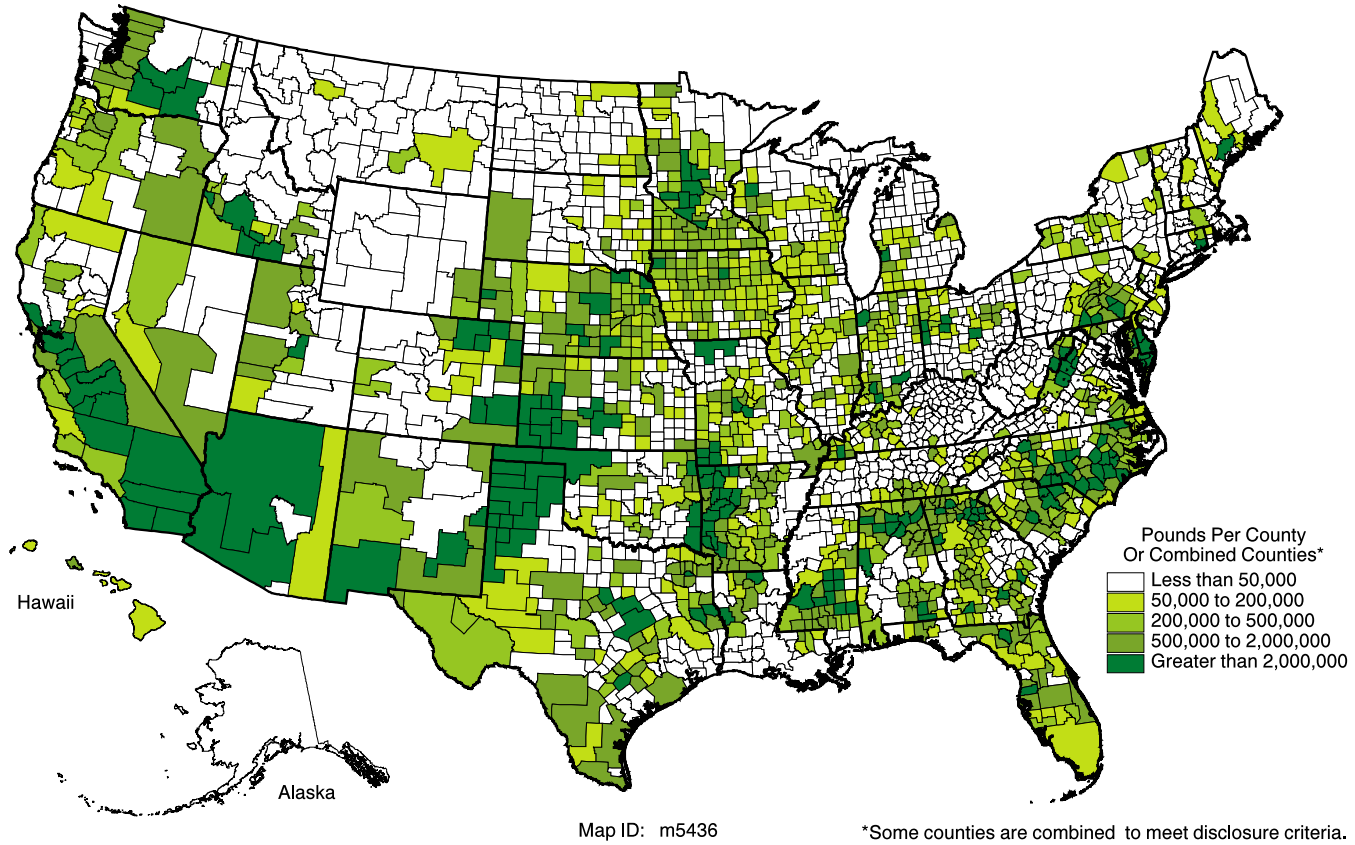


Figure 28 Pounds of farm-level excess nutrients per farm



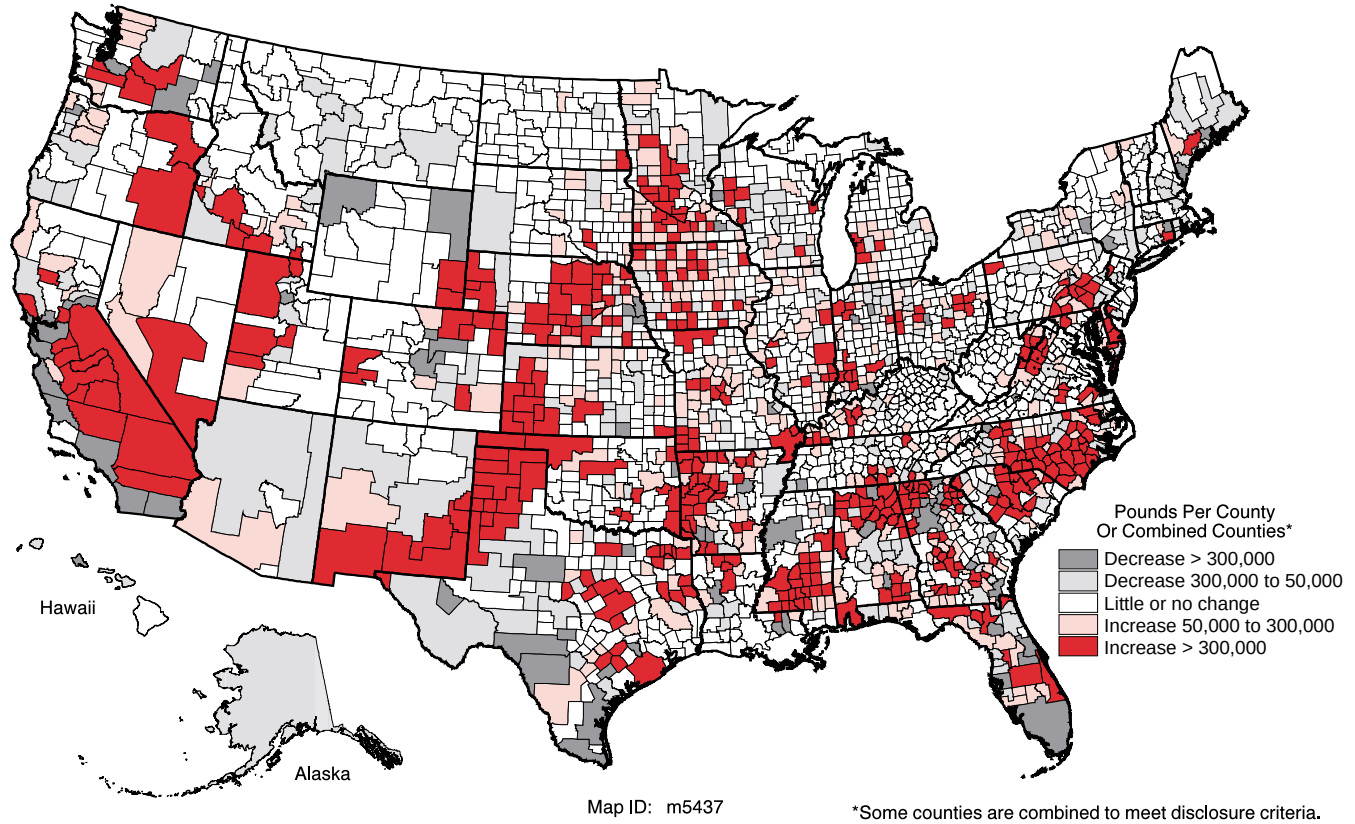
Map 28 Excess manure nitrogen assuming no export of manure from farm, 1997



Map ID: m5436

*Some counties are combined to meet disclosure criteria.

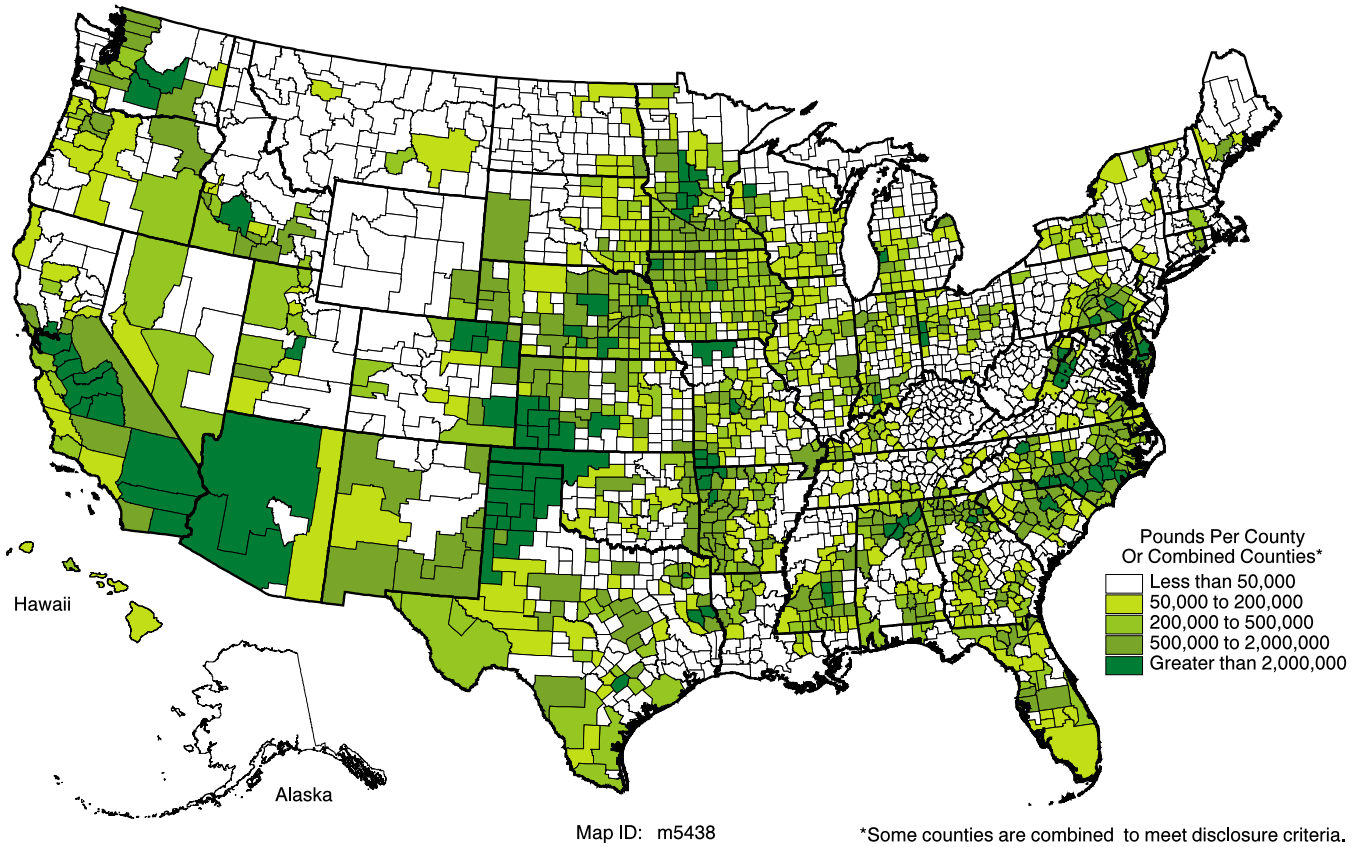
Map 29 Change in excess manure nitrogen assuming no export of manure from farm, 1982 to 1997



Map ID: m5437

*Some counties are combined to meet disclosure criteria.

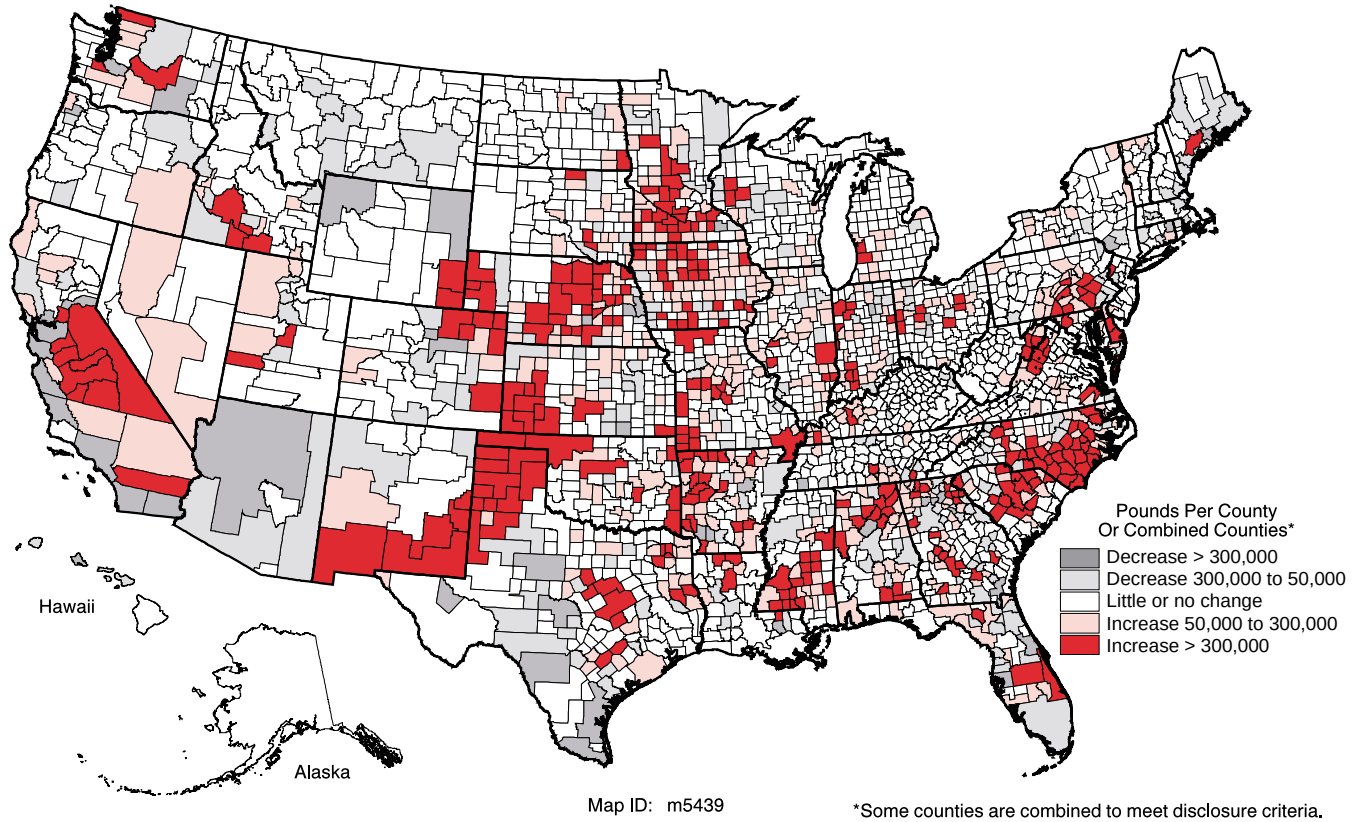
Map 30 Excess manure phosphorus assuming no export of manure from farm, 1997



Map ID: m5438

*Some counties are combined to meet disclosure criteria.

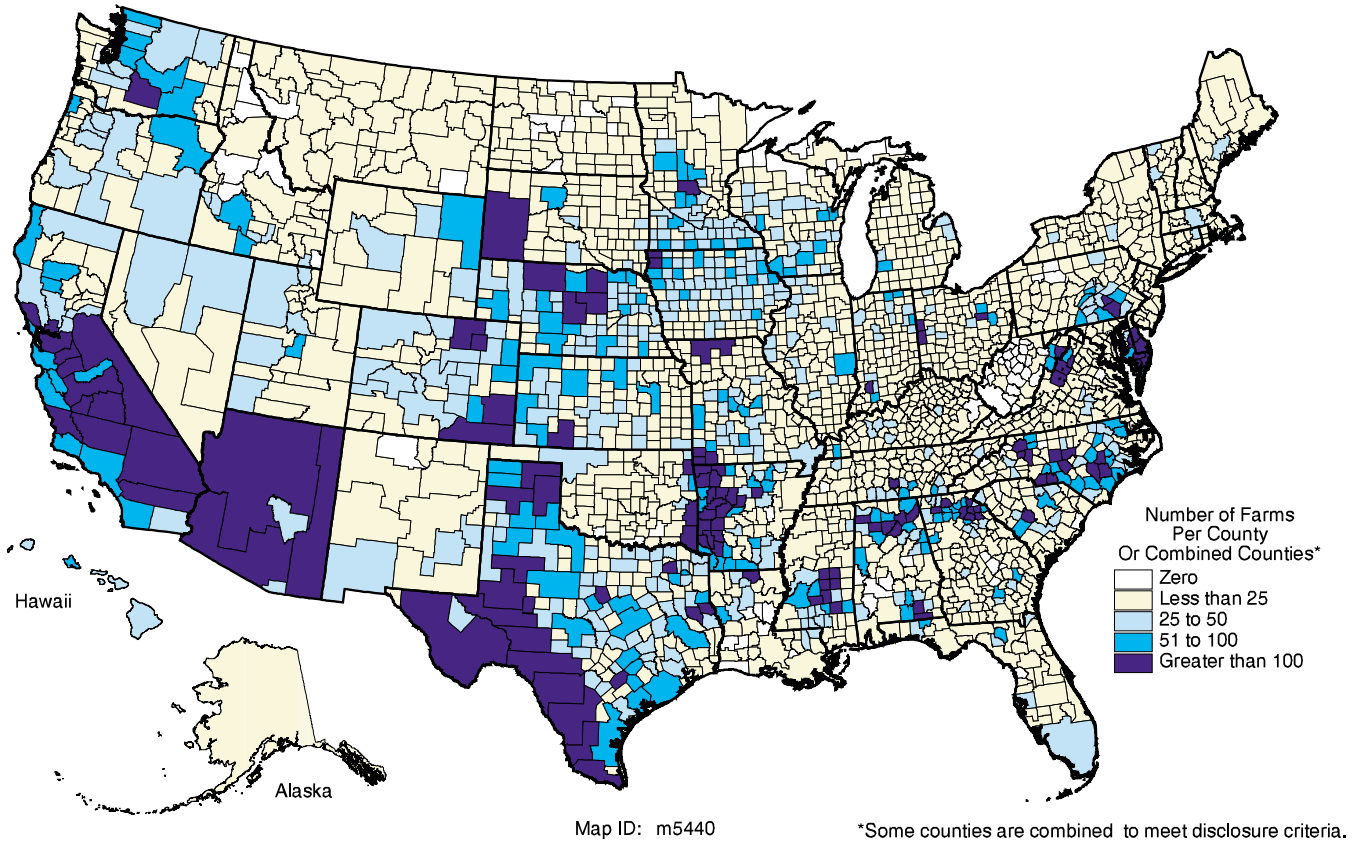
Map 31 Change in excess manure phosphorus assuming no export of manure from farm, 1982 to 1997



Map ID: m5439

*Some counties are combined to meet disclosure criteria.

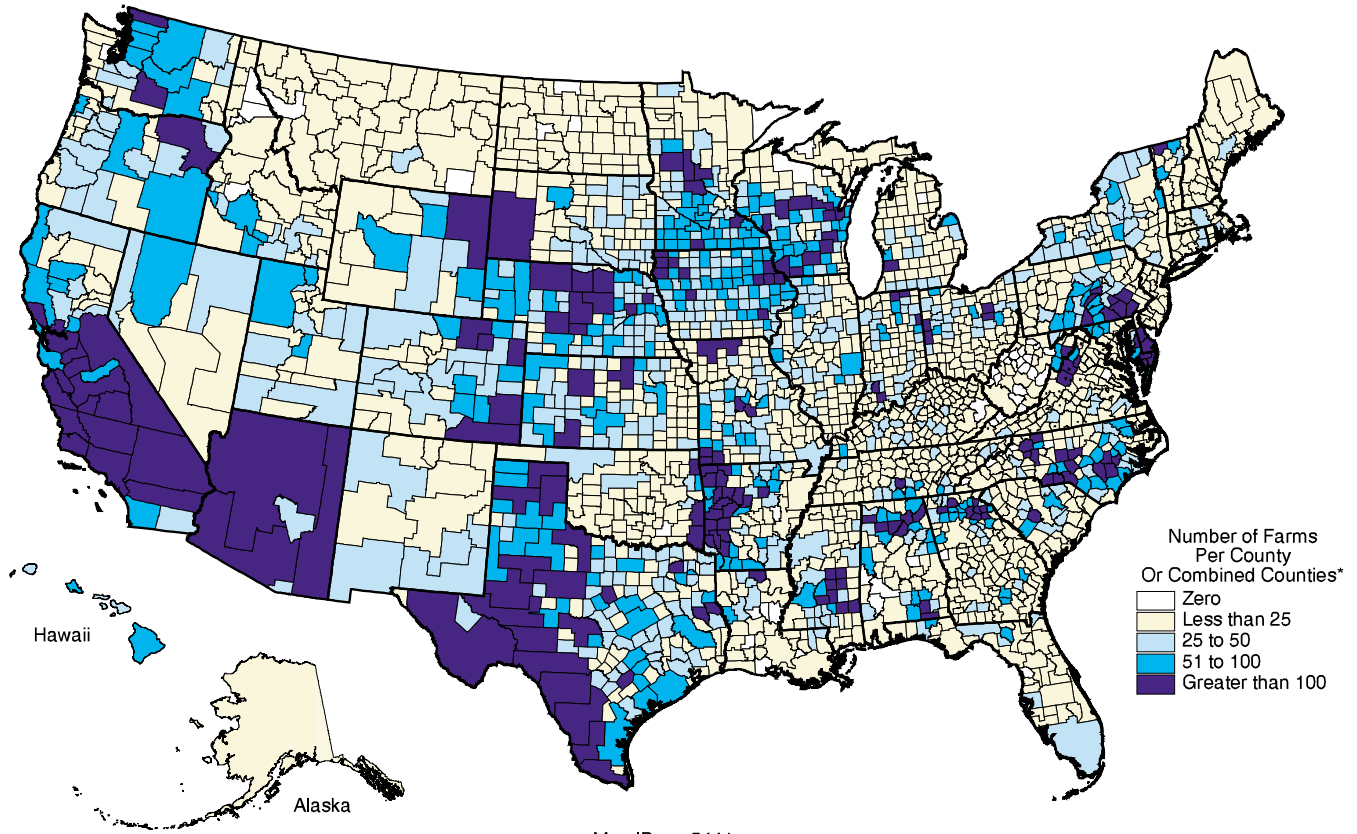
Map 32 Number of farms with the potential for excess nitrogen assuming no export of manure from farm, 1997



Map ID: m5440

*Some counties are combined to meet disclosure criteria.

Map 33 Number of farms with the potential for excess phosphorus assuming no export of manure from farm, 1997



Map ID: m5441

*Some counties are combined to meet disclosure criteria.

Table 18 Farm-level excess nutrients according to livestock type, 1982-1997

	1982			1987			1992			1997		
	Operations with excess nutrients	Million pounds of excess nutrients	Percent of total excess nutrients	Operations with excess nutrients	Million pounds of excess nutrients	Percent of total excess nutrients	Operations with excess nutrients	Million pounds of excess nutrients	Percent of total excess nutrients	Operations with excess nutrients	Million pounds of excess nutrients	Percent of total excess nutrients
Manure nitrogen												
All livestock operations	83,155	898.948	100	83,586	1,112.700	100	76,111	1,224.022	100	65,751	1,472.720	100
Based on all AU on farms*												
Farms with fattened cattle	5,773	215.659	24	6,080	249.487	22	5,045	251.384	21	3,269	280.650	19
Farms with milk cows	9,654	77.532	9	9,779	95.311	9	8,691	112.774	9	7,415	136.967	9
Farms with other beef and dairy	34,755	328.744	37	36,452	393.340	35	33,993	426.485	35	32,287	521.149	35
Farms with swine	20,329	57.804	6	20,510	69.451	6	19,142	84.243	7	11,370	138.869	9
Farms with poultry	32,334	599.845	67	30,498	755.358	68	27,136	830.360	68	26,683	967.291	66
Based on specific livestock types only**												
Fattened cattle	5,091	196.963	22	5,411	229.781	21	4,328	230.657	19	2,865	265.888	18
Milk cows	9,001	64.281	7	9,143	79.501	7	8,063	95.015	8	6,932	115.009	8
Other beef and dairy	24,956	6.640	1	26,913	7.882	1	24,163	8.454	1	22,645	9.157	1
Swine	19,165	28.721	3	19,468	37.436	3	18,317	56.172	5	10,932	114.438	8
Poultry	31,991	594.472	66	30,203	749.032	67	26,907	823.920	67	26,515	956.086	65
Manure phosphorus												
All livestock operations	123,248	573.285	100	120,210	689.172	100	108,143	755.631	100	89,028	929.109	100
Based on all AU on farms*												
Farms with fattened cattle	11,794	175.311	31	11,341	194.317	28	8,727	192.594	25	5,785	211.926	23
Farms with milk cows	24,911	51.063	9	23,669	59.476	9	21,869	69.858	9	16,806	84.032	9
Farms with other beef and dairy	58,768	244.407	43	58,223	277.312	40	54,259	294.007	39	48,274	351.181	38
Farms with swine	37,131	74.993	13	36,421	88.165	13	31,774	106.375	14	19,039	176.378	19
Farms with poultry	36,494	322.081	56	33,257	399.415	58	29,297	437.331	58	28,469	504.987	54
Based on specific livestock types only**												
Fattened cattle	8,029	154.881	27	8,031	174.018	25	6,150	172.642	23	4,158	196.257	21
Milk cows	20,147	35.787	6	19,321	42.342	6	17,736	50.787	7	14,027	63.114	7
Other beef and dairy	30,462	6.530	1	32,074	7.611	1	29,407	8.008	1	27,713	8.593	1
Swine	32,871	46.349	8	32,963	58.753	9	29,374	80.053	11	17,846	153.894	17
Poultry	35,003	315.199	55	32,265	391.609	57	28,699	429.355	57	28,062	492.046	53

* These estimates of farm-level excess nutrients include livestock of all types on the farm. Excess nutrients and the number of farms summed over livestock types will exceed the total because many farms have more than one animal type.

** These estimates of farm-level excess nutrients include only the specific livestock type and ignore recoverable manure from other livestock types on the farm. Excess nutrients summed over livestock types consequently will be less than the total. The sum of the number of farms, however, may exceed the total if many farms show excess nutrients for more than one livestock type.

County-level excess nutrients

Farm-level excess nutrients overstate the potential for overapplication of manure because of the unrealistic restriction that farms cannot export manure to surrounding properties. County-level excess nutrients are estimated assuming that all acres of the 24 crops and pastureland in a county are available for land application. Although estimates of county-level excess nutrients understate the extent of the problem because all available land within a county could not possibly be used for manure application, the estimates nevertheless are useful indicators of which counties face serious problems with livestock waste utilization and disposal. Where recoverable manure nutrients exceed the assimilative capacity of an entire county, the potential is high for runoff and leaching of manure nutrients and subsequent water quality problems. The existence of county-level excess nutrients is therefore an indicator of the potential for water quality degradation in those counties. (The analysis does not account for manure utilization technologies other than land application. Where alternatives to land applicaiton have been adopted, the county-level excess manure nutrients will be overestimated.)

For the Nation as a whole, the 1.5 billion pounds of farm-level excess nitrogen in 1997 reduced to 116 million pounds of county-level excess nitrogen. This indicates that the assimilative capacity of most counties is adequate to handle the manure nitrogen generated if the distribution problem could be solved. Phosphorus, however, is more of a problem. About a fifth (189 million pounds) of the 929 million pounds of farm-level excess phosphorus in 1997 exceeded the assimilative capacity at the county level.

In 1997, 73 counties had county-level excess manure nitrogen, whereas 160 counties had county-level excess manure phosphorus. (All the counties with excess manure nitrogen also had excess manure phosphorus.) Changes over time in the number of counties with county-level excess nutrients are an indication of whether the situation is improving or worsening. Figure 29 shows that the number of counties with excess manure nutrients has significantly increased since 1982, suggesting that the situation is worsening.

The 73 counties with county-level excess manure nitrogen in 1997 had 9,767 operations with farm-level excess manure nitrogen (table 19). Of these, 5,647 were operations where broilers comprised 50 percent or more of the animal units on the farm, and another 2,388 were operations where other types of poultry were the dominant type on the farm. Altogether, poultry operations comprised 82 percent of the operations with farm-level excess nitrogen in these counties. For phosphorus, however, dairy and swine operations were also important. The 160 counties with county-level excess phosphorus in 1997 had 21,320 operations with farm-level excess manure phosphorus (table 20). Of these, 64 percent had poultry as the dominant livestock type on the farm, 14 percent had milk cows as the dominant livestock type, and 11 percent had swine as the dominant livestock type.

Although livestock operations in counties with county-level excess nutrients need to explore alternatives to land application, not all of the operations in these counties need to adopt alternatives. If the farms contributing the most excess nutrients were to adopt alternatives to land application, the remaining farms could continue to use land application without exceeding the assimilative capacity in the county, assuming no distribution constraints. For example, the minimum number of operations that would be required to adopt alternatives to land application in the 73 counties with excess county-level nitrogen in 1997 is 1,047, about 11 percent of the operations that had excess nitrogen in those counties (table 19). This estimate was obtained by adding up the farm-level excess nitrogen for operations with the largest excess nitrogen until the county excess was surpassed. A similar result was obtained for phosphorus. The minimum number of operations required to adopt alternatives to land application in the 160 counties with excess county-level phosphorus in 1997 is 2,727, about 13 percent (table 20).

Figure 29 Number of counties with county-level excess nutrients

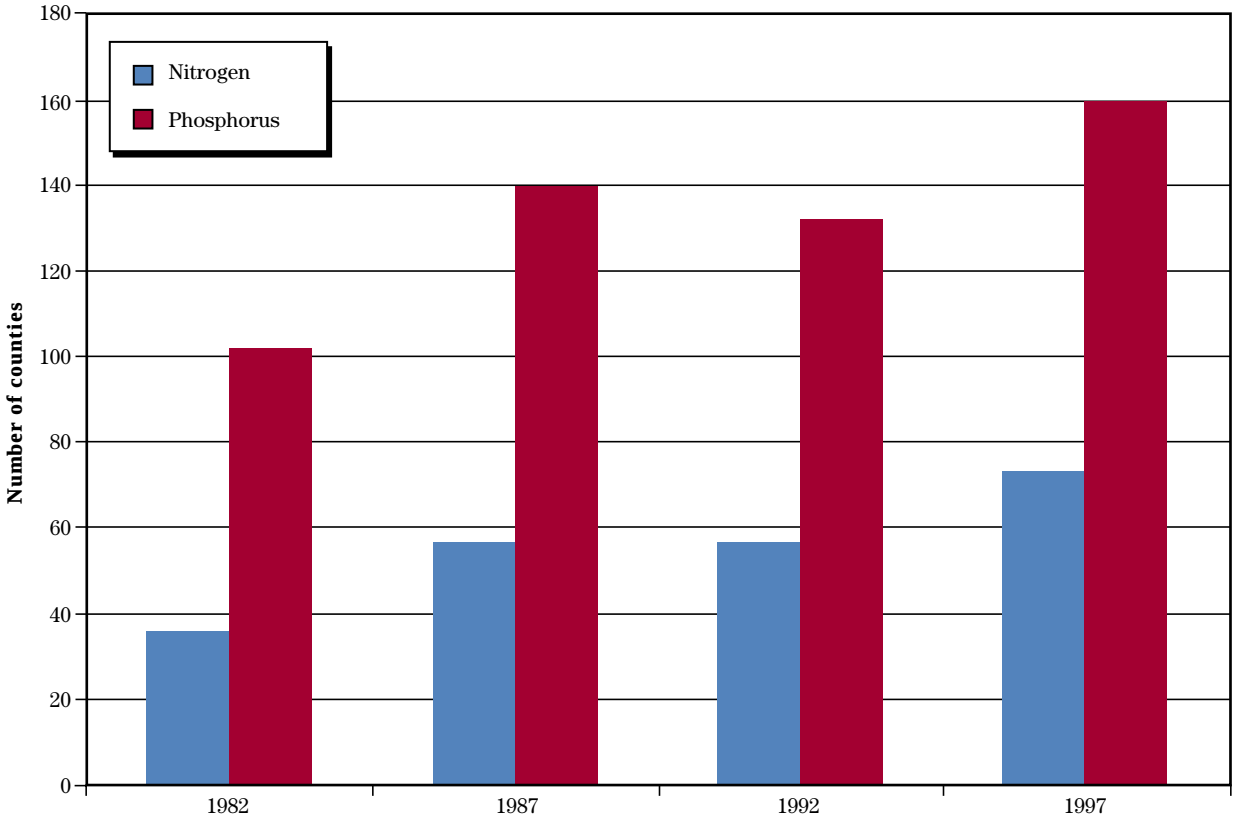


Table 19 Profile of operations in the 73 counties that had county-level excess manure nitrogen in 1997

Enterprise type based on dominant animal type	--- Farms with acres of 24 crops or pastureland ---			-- Farms with none of the 24 crops or pastureland --		Minimum number of farms requiring utilization alternatives to dissipate county excess*
	Number of operations	Farm-level excess manure nitrogen, million pounds	Acres per farm	Number of operations	Farm-level excess manure nitrogen, million pounds	
Fattened cattle dominant						
>75% of total AU	1	d	d	2	d	0
50–75% of total AU	3	d	d	3	d	0
Milk cows dominant						
>75% of total AU	79	2.552	92	97	6.089	5
50–75% of total AU	56	1.665	121	39	3.222	7
Other beef and dairy dominant						
>75% of total AU	54	0.198	85	283	0.102	0
50–75% of total AU	321	3.243	160	29	0.335	6
Swine dominant**						
>75% of total AU						
Grow-finish farms	344	9.372	87	88	2.064	33
Farrowing farms	1	d	d	0	0	0
Farrow-finish farms	119	3.892	117	90	2.118	27
50–75% of total AU	57	2.233	176	5	0.224	8
Layers and pullets dominant***						
>75% of total AU						
Pullets only	198	1.595	35	145	1.134	13
Layers only	546	10.346	38	328	8.185	45
Pullets and layers mixed	20	1.981	75	32	10.097	4
50–75% of total AU	282	3.364	75	15	0.260	13
Broilers dominant						
>75% of total AU	3,051	105.057	50	1,454	46.786	668
50-75% of total AU	1,106	25.333	123	36	0.877	100
Turkeys dominant						
>75% of total AU	521	33.650	109	221	13.049	106
50-75% of total AU	70	3.218	225	10	0.586	7
Mixed, no dominant livestock type	59	1.302	196	2	d	5
Total	6,888	209.064	80	2,879	95.164	1,047

* Minimum number of farms per county was estimated by adding up the farms with the largest excess nutrients in a county until the county excess was surpassed.

** Grow-finish farms are farms where hogs for slaughter are at least 95 percent of the swine animal units on the farm. Farrowing farms are farms where hogs for breeding are at least 95 percent of the swine animal units on the farm. Farrow-finish farms are the farms that have a mix of hogs for slaughter and breeding hogs that together comprise at least 75 percent of the animal units on the farm.

*** Pullet only farms are farms where pullets are at least 95 percent of the pullet and layer animal units on the farm. Layer only farms are farms where layers are at least 95 percent of the pullet and layer animal units on the farm. Pullet and layer mixed farms are the remaining farms that have a mix of layers and pullets that together comprise at least 75 percent of the animal units on the farm.

d Denotes data withheld because of disclosure criteria.

Note: Two categories of dominant farms were derived: (All animal units on the farm (confined and not confined) were used to derive the dominant animal type.)

- Farms where the dominant type comprises at least 75 percent of the animal units on the farm.
- Farms where the dominant type comprises 50 to 75 percent of the animal units on the farm.

Table 20 Profile of operations in the 160 counties with county-level excess manure phosphorus in 1997

Enterprise type based on dominant animal type	Farms with acres of 24 crops or pastureland			Farms with none of the 24 crops or pastureland		Minimum number of farms requiring utilization alternatives to dissipate county excess*
	Number of operations	Farm-level excess manure phosphorus, million pounds	Acres per farm	Number of operations	Farm-level excess manure phosphorus, million pounds	
Fattened cattle dominant						
>75% of total AU	81	17.909	409	58	25.634	8
50–75% of total AU	85	2.276	177	35	0.461	4
Milk cows dominant						
>75% of total AU	1,186	11.204	137	292	5.373	34
50–75% of total AU	1,380	10.817	206	186	5.253	30
Other beef and dairy dominant						
>75% of total AU	454	0.258	42	842	0.209	1
50–75% of total AU	522	2.178	182	59	0.251	11
Swine dominant**						
>75% of total AU						
Grow-finish farms	927	21.098	164	266	7.728	371
Farrowing farms	5	0.044	32	1	d	2
Farrow-finish farms	585	14.679	220	288	7.310	111
50–75% of total AU	244	4.448	182	19	0.277	77
Layers and pullets dominant***						
>75% of total AU						
Pullets only	325	2.163	59	223	1.702	21
Layers only	872	12.024	59	646	12.589	117
Pullets and layers mixed	45	4.188	190	65	10.144	17
50–75% of total AU	426	3.712	106	20	0.249	41
Broilers dominant						
>75% of total AU	4,773	67.712	78	2,980	38.506	1,159
50–75% of total AU	1,471	13.996	132	48	0.513	155
Turkeys dominant						
>75% of total AU	1,031	50.295	156	509	30.561	486
50–75% of total AU	127	5.313	262	13	0.761	61
Mixed, no dominant livestock type	226	2.049	228	5	d	21
Total	14,765	246.363	127	6,555	147.538	2,727

* Minimum number of farms per county was estimated by adding up the farms with the largest excess nutrients in a county until the county excess was surpassed.

** Grow-finish farms are farms where hogs for slaughter are at least 95 percent of the swine animal units on the farm. Farrowing farms are farms where hogs for breeding are at least 95 percent of the swine animal units on the farm. Farrow-finish farms are the farms that have a mix of hogs for slaughter and breeding hogs that together comprise at least 75 percent of the animal units on the farm.

*** Pullet only farms are farms where pullets are at least 95 percent of the pullet and layer animal units on the farm. Layer only farms are farms where layers are at least 95 percent of the pullet and layer animal units on the farm. Pullet and layer mixed farms are the remaining farms that have a mix of layers and pullets that together comprise at least 75 percent of the animal units on the farm.

d Denotes data withheld because of disclosure criteria.

Note: Two categories of dominant farms were derived: (All animal units on the farm (confined and not confined) were used to derive the dominant animal type.)

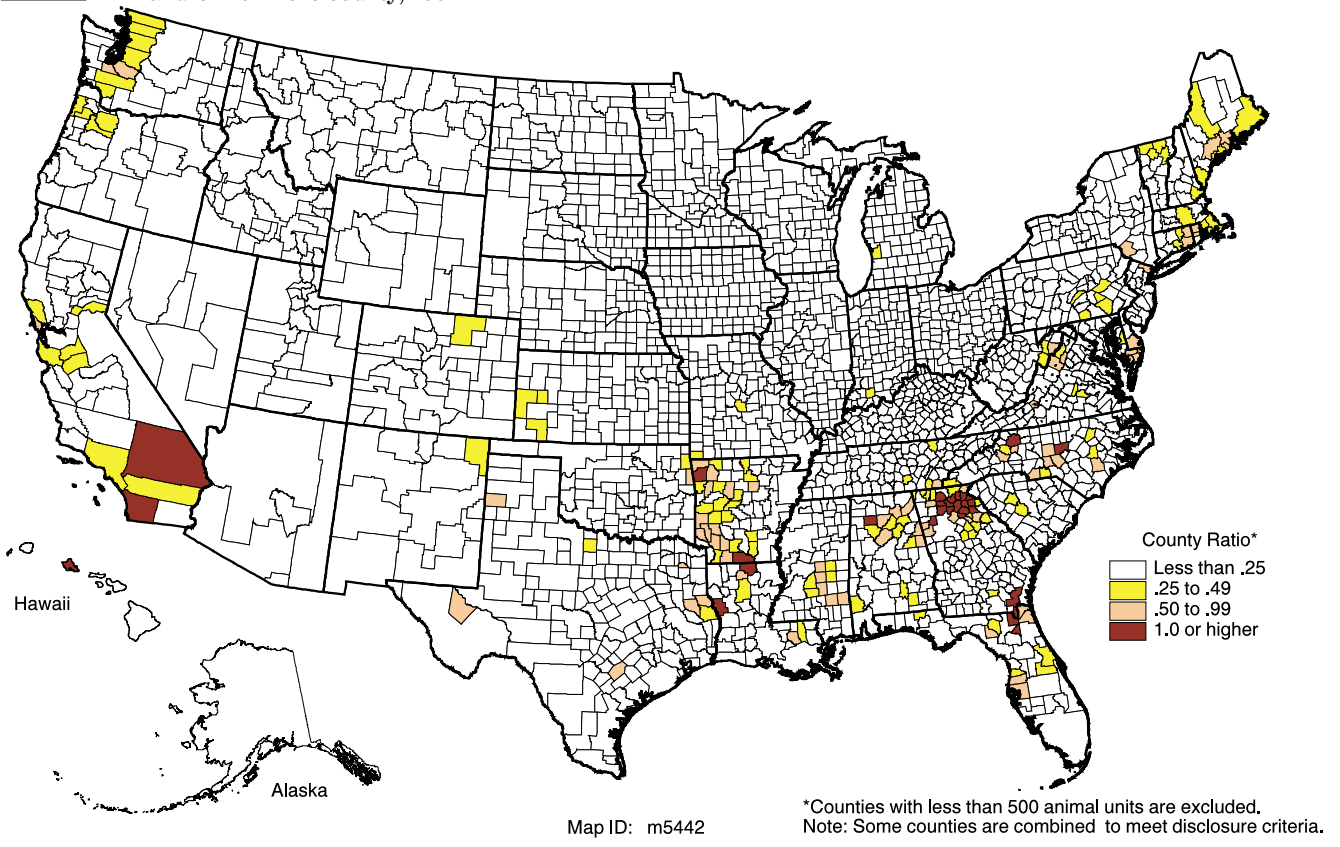
- Farms where the dominant type comprises at least 75 percent of the animal units on the farm.
- Farms where the dominant type comprises 50 to 75 percent of the animal units on the farm.

A related measure that is useful in assessing the extent of the manure utilization and disposal problem is the ratio of recoverable manure to the assimilative capacity of the cropland and pastureland within a county, originally published by Lander, Moffitt, and Alt (1998). A ratio greater than 1 indicates that the county has county-level excess nutrients. The following additional categories were created to add perspective to the potential for animal waste utilization and disposal problems:

- *A ratio of 0.50 to 0.99 indicates that 50 to 99 percent of nutrients taken up and removed by crops or applied to pasture could be supplied from manure generated within the county.* The capacity of the cropland and pastureland in these counties to assimilate nutrients exceeds the production of manure nutrients by only a factor of 1 to 2. It is highly unlikely that all the available assimilative capacity in a county could actually be used. Moreover, livestock operations are often distributed unevenly throughout a county, creating pockets within counties where excess nutrients may be produced. Counties in this category probably have significant animal waste problems even though recoverable manure nutrients are less than the assimilative capacity.
- *A ratio of 0.25 to 0.49 indicates that 25 to 49 percent of nutrients taken up and removed by crops or applied to pasture could be supplied from manure generated within the county.* Alternatively, manure nutrients would need to be applied to 25 to 49 percent of the land available for manure application within the county to avoid production of excess nutrients. This is greater than the percentage of cropland that is used for land application of animal wastes reported in farmer surveys (USDA, 1997). These counties may have localized problems with animal waste utilization and disposal, and would be expected to have problems that are more widespread if animal production increases significantly in the future.
- *A ratio of less than 0.25 indicates that less than 25 percent of nutrients taken up and removed by crops or applied to pasture could be supplied from manure generated within the county.* For the county as a whole, these quantities of manure nutrients would not be expected to cause animal waste problems as long as producers adhere to appropriate nutrient management practices.

The county ratio of recoverable manure nutrients to assimilative capacity is shown for 1982 and 1997 in maps 34 and 35 for nitrogen and maps 36 and 37 for phosphorus. Counties with less than 500 animal units (confined and not confined) were excluded from the analysis. Counties that have potential animal waste problems tend to be grouped together. Moreover, as the number of counties with high ratios increased from 1982 to 1997, the additional counties tended to occur in these same areas of concentration. All but three of the counties with excess nitrogen (county ratios greater than 1.0) were in the Southeast in a region extending from Arkansas and Louisiana to Virginia. Counties with excess phosphorus were also numerous throughout the Southeast, but additional counties were located in the Northeast (including the Delmarva Peninsula), the extreme Northwest, California, and the Great Plains. The number of counties with ratios of 0.5 or greater, representing counties that are the most likely to have animal waste utilization and disposal problems, increased from 112 to 165 (47%) between 1982 and 1997 for nitrogen and from 310 to 374 (21%) for phosphorus (table 21, fig. 30).

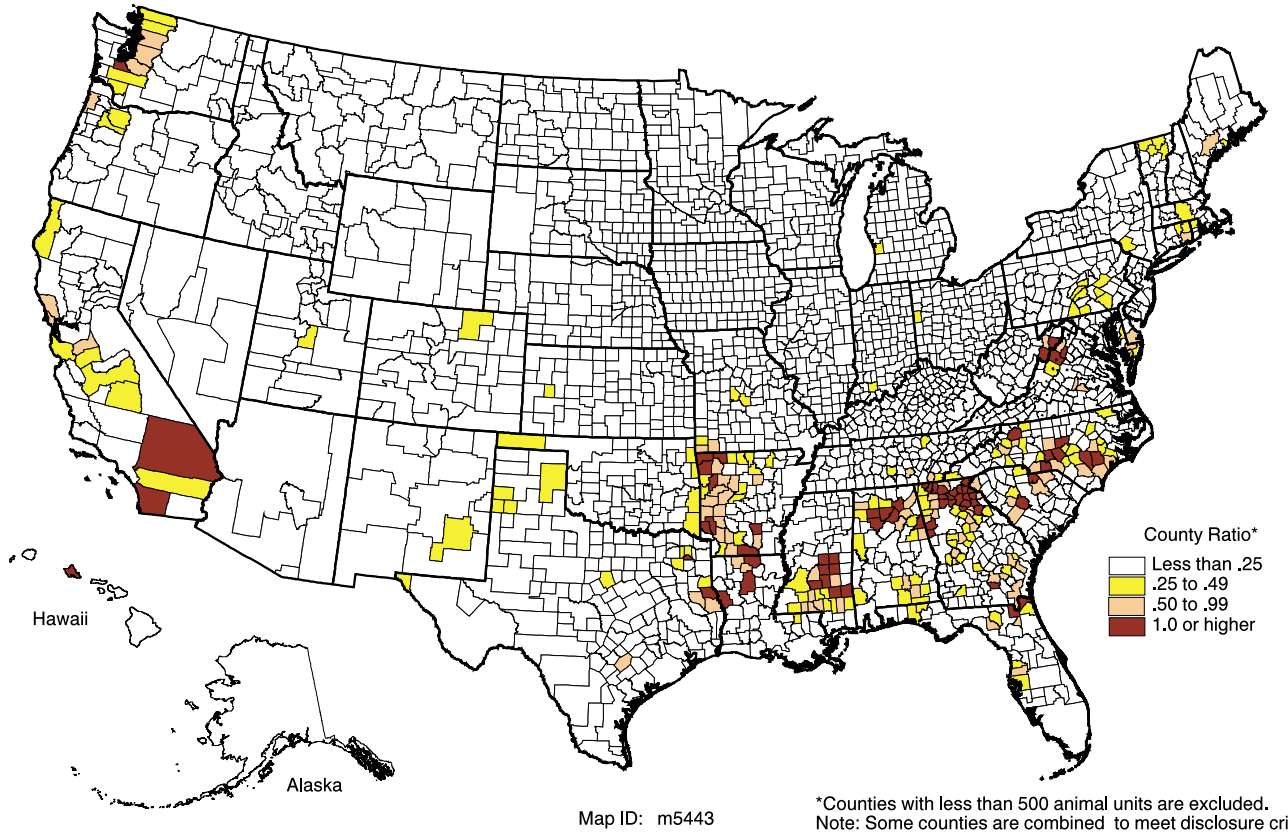
Map 34 Ratio of manure available for land application to assimilative capacity for nitrogen, assuming off-farm export of manure within the county, 1982



Map ID: m5442

*Counties with less than 500 animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

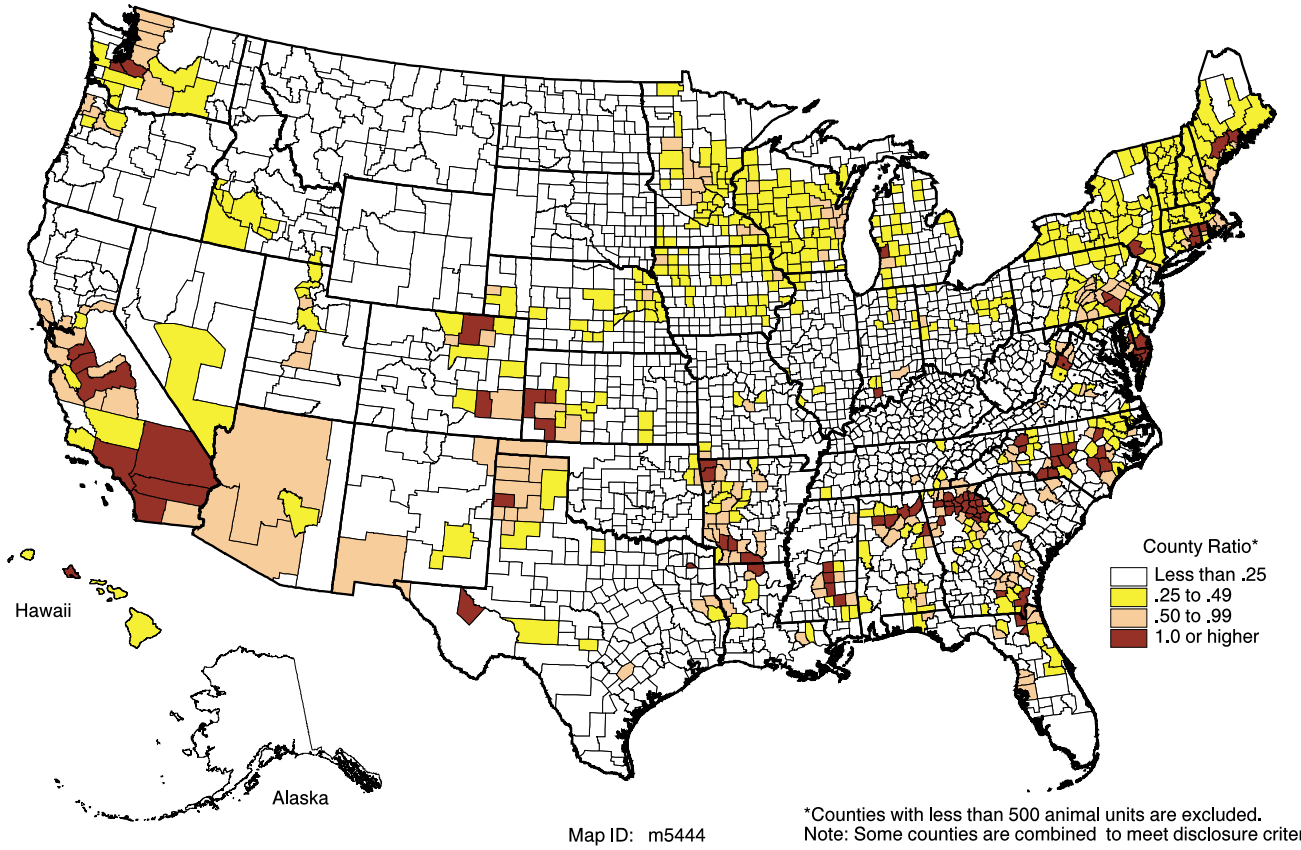
Map 35 Ratio of manure available for land application to assimilative capacity for nitrogen, assuming off-farm export of manure within the county, 1997



Map ID: m5443

*Counties with less than 500 animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

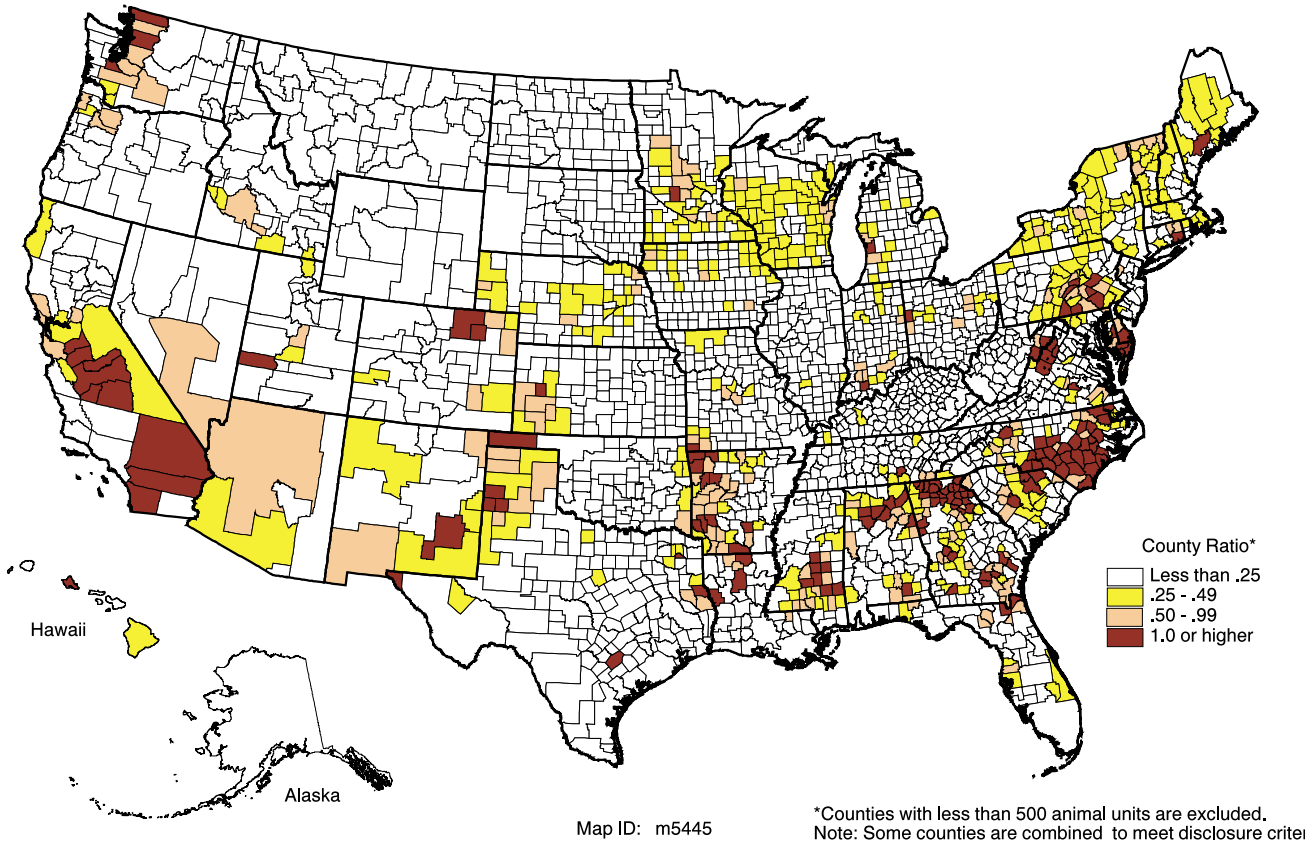
Map 36 Ratio of manure available for land application to assimilative capacity for phosphorus, assuming off-farm export of manure within the county, 1982



Map ID: m5444

*Counties with less than 500 animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

Map 37 Ratio of manure available for land application to assimilative capacity for phosphorus, assuming off-farm export of manure within the county, 1997



Map ID: m5445

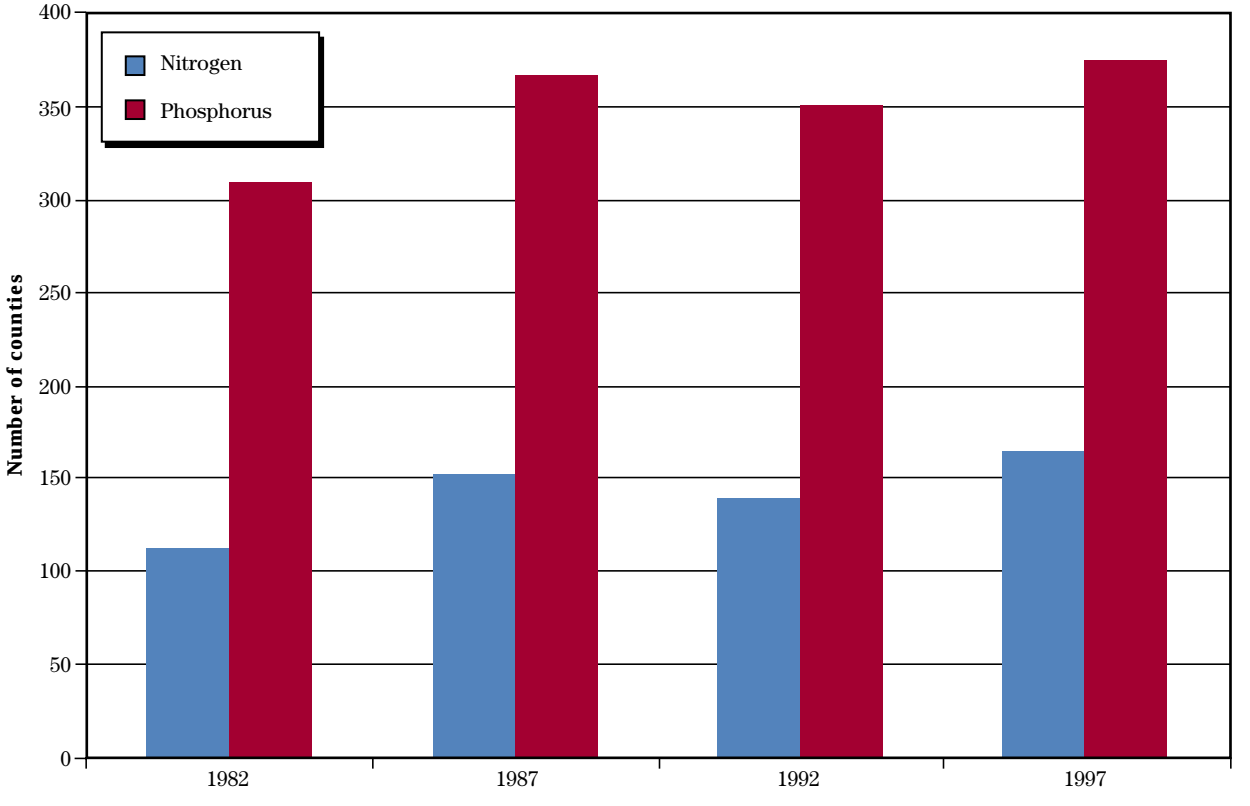
*Counties with less than 500 animal units are excluded.
Note: Some counties are combined to meet disclosure criteria.

Table 21 Number of counties for three categories of county ratios, 1982-1997

County ratio of recoverable manure nutrients to assimilative capacity	1982	1987	1992	1997
	- - - - - - - - - Number of counties* - - - - - - - - -			
Manure nitrogen				
0.25 to <0.50	130	155	136	156
0.50 to <1.0	76	96	82	92
1.0 or higher	36	57	57**	73
Manure phosphorus				
0.25 to <0.50	473	452	385	375
0.50 to <1.0	208	227	219	214
1.0 or higher	102	140	132**	160

Note: Counties with less than 500 animal units (confined and not confined) are excluded.
* Number of actual counties, not combined counties shown in maps 34 to 37.
** Lander, Moffitt, and Alt (1998) reported for 1992 that the county ratio was 1.0 or higher in 35 counties for nitrogen and 107 counties for phosphorus. The higher numbers shown in this table for 1992 result from modifications to the algorithms and revisions in parameters used to calculate animal units.

Figure 30 Number of counties with ratios of recoverable manure nutrients to assimilative capacity of 0.5 or more



Summary of findings

Farm numbers and farm size

For this analysis, livestock include beef cattle, dairy cattle, swine, and poultry. Animal units were aggregated to five major livestock types: fattened cattle, milk cows, other beef and dairy (consisting of cattle other than fattened cattle and milk cows), swine, and poultry. Animal units were estimated for both confined livestock and livestock not held in confinement. Confined livestock are defined to be livestock held in a feedlot or other confinement facility such that sufficient amounts of manure would accumulate requiring removal on a regular basis. Nearly all fattened cattle and poultry and most of the swine and milk cows were assumed to be confined, whereas less than 10 percent of other beef and dairy were assumed to be confined.

The structure of animal agriculture changed dramatically between 1982 and 1997 as the number of livestock operations fell and livestock became more concentrated on fewer, but larger operations.

- The number of livestock operations in the Nation steadily decreased from 1,385,205 in 1982 to 1,048,731 in 1997, a 24 percent decrease. About 50 percent of livestock operations had confined livestock. The number of livestock operations with confined animals decreased from 728,539 in 1982 to 529,658 in 1997, a decrease of 27 percent. The greatest loss of farms with confined livestock between 1982 and 1997 occurred among operations with swine—a 64-percent decrease. Operations with confined fattened cattle decreased 52 percent, operations with confined milk cows decreased 47 percent, and operations with confined poultry decreased 46 percent. Nearly all the lost farms were small- and medium-sized operations. The number of large operations (more than 300 animal units) increased 21 percent.

- In spite of losing nearly a fourth of the livestock operations between 1982 and 1997, the total number of animal units (including both confined and not confined) has remained fairly constant at about 91 to 95 million. In 1997, 40 percent of these were confined (38 million animal units), which was up about 7 percent from 1982.

- Although the overall livestock population has remained fairly stable over this period, the mix of livestock types has shifted significantly. In 1982, 32 percent of the confined animal units were milk cows. By 1997, the share for milk cows had fallen to 26 percent, which was offset by increases in the shares for poultry and swine.

- Operations with confined livestock have become more spatially concentrated. Fewer counties accounted for the bulk of the confined livestock populations in 1997 than in 1982 for each of the five major livestock types.

- Fattened cattle accounted for about a fourth of the confined livestock in 1997. The vast majority of confined fattened cattle are raised on large operations; in 1997, 80 percent of confined fattened cattle were on farms with at least 1,000 fattened cattle animal units.

- Milk cows were the only major livestock type to show substantial decreases in animal units—confined milk cows decreased 13 percent between 1982 and 1997 largely as a result of the loss of smaller dairies. In 1982, the majority of confined milk cows were on farms with less than 150 milk cow animal units; by 1997, however, over half of the milk cows were on farms with at least 300 milk cow animal units.

- The shift in the distribution of livestock from small operations to large operations was more dramatic for swine than for any other livestock type. In 1982, only 14 percent of confined swine were on farms with at least 300 swine animal units; by 1997, this had increased to 60 percent. The number of confined swine animal units on the largest operations (at least 1,000 swine animal units) increased 1,238 percent.

- Poultry animal units increased faster than any other livestock type; confined poultry animal units increased 52 percent between 1982 and 1997. This increase was limited to the larger operations; confined poultry animal units on small operations (less than 50 poultry animal units) decreased more than 50 percent.

Manure production

Trends in manure nutrients are directly related to trends in animal units. As livestock operations have become fewer, larger, and more concentrated in the major production areas, manure nutrients have also become more concentrated in those regions. In poultry production areas, manure nutrients have become even more concentrated because poultry liter contains two to four times as much manure nutrients per ton of manure as other livestock types.

- In 1997, 12.9 billion pounds of manure nitrogen and 3.8 billion pounds of manure phosphorus *(as excreted)* were produced by the 95 million animal units in the Nation, representing 3 percent and 5 percent increases over 1982 amounts, respectively. About half of this was produced by livestock held in confinement.

- Recoverable manure nutrients is the portion of *as excreted* manure nutrients that can be collected from confinement facilities after accounting for losses during collection, transfer, storage, and treatment. Recoverable manure nutrients is, therefore, the amount that is available for land application. In 1997, about 20 percent of the total nitrogen produced and 37 percent of the total phosphorus produced were recoverable from confinement facilities, representing 17 percent and 19 percent increases over 1982 amounts, respectively.

- Poultry had the largest share of recoverable manure nutrients—45 percent of the nitrogen and 38 percent of the phosphorus in 1997. The poultry share increased 10 percentage points from 1982 to 1997 for nitrogen and 8 percentage points for phosphorus. Recoverable manure nutrients increased 52 percent for poultry and 35 to 36 percent for swine from 1982 to 1997. Recoverable manure nutrients from fattened cattle increased only a small amount (2 percent), while recoverable manure nutrients from milk cows and other cattle decreased.

- The volume of recoverable manure nutrients from the largest operations (at least 1,000 animal units) more than doubled between 1982 and 1997. A substantial decrease occurred in the volume produced by operations that had less than 150 animal units.

As Excreted and Recoverable Manure Nutrients

	1982		1997	
	Nitrogen	Phosphorus	Nitrogen	Phosphorus
Manure nutrients as excreted				
Million pounds, all livestock	12,498	3,651	12,905	3,840
Percent from confined livestock	44	41	49	46
Percent from livestock not confined	56	59	51	54
Recoverable manure nutrients				
Million pounds	2,205	1,208	2,583	1,437
Percent of as excreted, all livestock	18	33	20	37

Land available for manure application and assimilative capacity

Land available for manure application fluctuates from year to year as land use and cropping patterns change. For this analysis, acres of 24 crops, cropland used as pasture, and half of the permanent pasture comprise the land available for manure application. The capacity of cropland and pastureland to assimilate nutrients was estimated to be the amount of nutrients taken up and removed at harvest for cropland and the amount that could generally be applied to pastureland without accumulating nutrients in the soil.

- The total amount of land available for manure application (all farms) in the U.S. fluctuated between 311 million acres and 390 million acres between 1982 and 1997. Of this, about half was available on livestock operations with confined animals.

- Confined animal units per acre of land available for manure application on farms with confined livestock averaged 0.19 animal units per acre in 1982 and 0.22 animal units per acre in 1997. The density was lowest on farms that had few livestock and highest on the large operations. In 1997, operations that had at least 1,000 animal units averaged 1.7 confined animal units per acre, up from an average of 1.2 in 1982.

- The assimilative capacity for nitrogen fluctuated between 33.5 billion pounds and 42.5 billion pounds over the four census years. The assimilative capacity for phosphorus, however, is much lower, ranging from 5.4 billion pounds to 6.6 billion pounds. These levels substantially exceed the amount of recoverable manure nitrogen and phosphorus generated by confined livestock.

Excess manure nutrients

Farms that produce more manure nutrients than can be applied to the land without accumulating nutrients in the soil have excess manure nutrients. In some cases a farm has sufficient cropland and pastureland to properly utilize the manure on the farm. In other cases the farm operator must use land owned or operated by others to avoid overapplying manure. Two estimates of excess manure nutrients were made. The first assumes that only land on the farm is available for land application, and is called *farm-level excess manure nutrients*. The second estimate assumes that all suitable cropland and pastureland within a county are available for application. This method is called *county-level excess manure nutrients*.

- Farm-level excess manure nutrients reflect the imbalance between assimilative capacity and the quantity of manure nutrients produced on the farm. Because farm-level excess nutrients can be dissipated by exporting manure to surrounding properties, which is a common practice in many areas, estimates provide a measure of off-farm export requirements. In 1997, there were 1.5 billion pounds of farm-level excess manure nitrogen and 0.9 billion pounds of farm-level excess manure phosphorus, representing about 60 percent of the recoverable manure nitrogen and 65 percent of the recoverable manure phosphorus.

- Farm-level excess nitrogen and phosphorus increased over 60 percent between 1982 and 1997. Because of the decreasing number of operations and the increasing production of excess manure nutrients, the average amount of excess nutrients produced per farm with excess manure more than doubled for both nitrogen and phosphorus. These estimates indicate that off-farm export requirements have increased dramatically as animal agriculture has become more concentrated in fewer areas and on larger operations.

- More operations had farm-level excess manure phosphorus (89,028 operations in 1997) than had farm-level excess manure nitrogen (65,751 operations in 1997). Farms that had poultry accounted for about two-thirds of the farm-level excess nitrogen and over half of the farm-level excess phosphorus in each of the four census years. The second most significant source was fattened cattle, accounting for about 20 percent of both excess nitrogen and excess phosphorus.

- County-level excess nutrients allow for off-farm export of animal waste within the county. In 1997, the 1.5 billion pounds of farm-level excess nitrogen reduced to 116 million pounds of county-level excess nitrogen, and the 929 million pounds of farm-level excess phosphorus reduced to 189 million pounds of county-level excess phosphorus.

- Although county-level estimates of excess nutrients understate the potential for over-application of manure because all available cropland and pastureland within a county could not possibly be used for manure application, they nevertheless are useful indicators of which counties face serious problems with livestock waste utilization and disposal. Where recoverable manure nutrients exceed the assimilative capacity of an entire county, the potential is high for runoff and leaching of manure nutrients and subsequent water quality problems. In 1997, 73 counties had county-level excess manure nitrogen and 160 counties had county-level excess manure phosphorus.

- In the 73 counties that had county-level excess manure nitrogen, 82 percent of the operations with farm-level excess nitrogen had poultry as the dominant livestock type. In the 160 counties that had county-level excess manure phosphorus, 64 percent of the operations with farm-level excess phosphorus had poultry as the dominant livestock type on the farm, 14 percent had milk cows as the dominant livestock type, and 11 percent had swine as the dominant livestock type.

- A related measure that is useful in assessing the extent of the manure utilization and disposal problem is the ratio of recoverable manure to the assimilative capacity of the cropland and pastureland within a county. A ratio greater than 1 indicates that the county has county-level excess nutrients (described in previous bullets). Since all the available assimilative capacity in a county could never actually be used, a ratio of 0.5 is a more practical threshold for identifying counties that have potential problems. The number of counties in 1997 with ratios of 0.5 or greater totaled 165 for nitrogen and 374 for phosphorus.

- Changes over time in the number of counties that have county-level excess manure nutrients are an indication of whether the situation is improving or worsening. There were 37 more counties (103 percent increase) with county-level excess manure nitrogen in 1997 than in 1982, and 58 more counties (57 percent increase) with county-level excess manure phosphorus in 1997 than in 1982. These estimates indicate that problems associated with livestock waste utilization and disposal have become more widespread over the past two decades as the structure of animal agriculture shifted toward fewer and larger operations.

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Appendix A
Number of Livestock Operations and Animal Units by Farm Size, 1982–1997

Table A–1 Total number of livestock operations, 1982–1997

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
All livestock operations*					
Less than 25 total AU	660,425	577,488	496,206	472,335	–28
25 to <50 total AU	263,355	233,366	217,423	203,402	–23
50 to <150 total AU	336,505	297,081	275,128	246,220	–27
150 to <300 total AU	84,041	79,952	80,178	77,219	–8
300 to <1,000 total AU	35,437	35,697	38,666	41,534	+17
1,000 or more total AU	5,442	5,757	6,526	8,021	+47
All operations	1,385,205	1,229,341	1,114,127	1,048,731	–24
Potential CAFOs	4,963	6,016	7,831	11,242	+127
Livestock operations with fattened cattle					
Less than 25 fattened cattle AU	201,839	159,984	124,320	93,102	–54
25 to <50 fattened cattle AU	13,861	11,426	8,770	6,734	–51
50 to <150 fattened cattle AU	11,753	9,394	7,268	5,548	–53
150 to <300 fattened cattle AU	3,126	2,583	2,078	1,537	–51
300 to <1,000 fattened cattle AU	1,774	1,628	1,482	1,226	–31
1,000 or more fattened cattle AU	875	909	906	871	0
All operations	233,228	185,924	144,824	109,018	–53
Potential fattened cattle CAFOs	2,325	2,264	2,155	1,897	–18
Livestock operations with milk cows					
Less than 25 milk cow AU	108,310	60,968	41,046	28,687	–74
25 to <50 milk cow AU	56,864	40,855	28,653	18,419	–68
50 to <150 milk cow AU	91,881	81,359	68,130	52,856	–42
150 to <300 milk cow AU	10,392	10,860	10,561	9,680	–7
300 to <1,000 milk cow AU	3,385	3,628	4,022	4,534	+34
1,000 or more milk cow AU	456	615	920	1,303	+186
All operations	271,288	198,285	153,332	115,479	–57
Potential milk cow CAFOs	451	609	908	1,296	+187
Livestock operations with other beef and dairy cattle					
Less than 25 cattle AU	732,856	628,900	534,557	509,125	–31
25 to <50 cattle AU	265,114	237,806	227,532	216,932	–18
50 to <150 cattle AU	208,511	191,235	194,060	194,093	–7
150 to <300 cattle AU	42,914	41,265	43,232	46,110	+7
300 to <1,000 cattle AU	20,976	20,648	22,349	24,305	+16
1,000 or more cattle AU	3,158	3,039	3,222	3,671	+16
All operations	1,273,529	1,122,893	1,024,952	994,236	–22

See note and footnote at end of table.

Table A–1 Total number of livestock operations, 1982–1997—Continued

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
Livestock operations with swine					
Less than 25 swine AU	240,880	166,450	119,749	62,939	–74
25 to <50 swine AU	38,548	32,954	27,469	12,949	–66
50 to <150 swine AU	31,394	30,157	29,241	17,206	–45
150 to <300 swine AU	4,730	5,285	6,525	5,726	+21
300 to <1,000 swine AU	1,432	1,931	2,699	4,134	+189
1,000 or more swine AU	103	168	338	1,011	+882
All operations	317,087	236,945	186,021	103,965	–67
Potential swine CAFOs	1,040	1,392	2,269	4,374	+321
Livestock operations with poultry					
Less than 25 poultry AU	167,410	108,472	61,089	48,266	–71
25 to <50 poultry AU	9,562	7,503	5,304	4,512	–53
50 to <150 poultry AU	14,044	14,142	13,422	12,654	–10
150 to <300 poultry AU	3,175	3,909	5,008	6,129	+93
300 to <1,000 poultry AU	1,786	2,333	2,690	3,312	+85
1,000 or more poultry AU	362	530	615	688	+90
All operations	196,339	136,889	88,128	75,561	–62
Potential poultry CAFOs	1,185	1,799	2,563	3,763	+218

* The sum of farms over livestock types will exceed the total number of farms because many farms have more than one livestock type.
Note: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.

Table A–2 Number of livestock operations with confined animals, 1982–1997

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
All livestock operations*					
Less than 25 total AU	112,732	97,507	75,425	57,061	–49
25 to <50 total AU	199,300	177,798	162,929	150,130	–25
50 to <150 total AU	302,934	265,272	241,216	209,670	–31
150 to <300 total AU	76,735	72,600	72,295	68,279	–11
300 to <1,000 total AU	31,930	32,214	34,841	37,093	+16
1,000 or more total AU	4,908	5,274	6,004	7,425	+51
All operations	728,539	650,665	592,710	529,658	–27
Potential CAFOs	4,963	6,016	7,831	11,242	+127
Livestock operations with fattened cattle					
Less than 25 fattened cattle AU	67,074	57,765	43,625	31,250	–53
25 to <50 fattened cattle AU	13,821	11,398	8,743	6,725	–51
50 to <150 fattened cattle AU	11,720	9,368	7,241	5,545	–53
150 to <300 fattened cattle AU	3,126	2,583	2,078	1,537	–51
300 to <1,000 fattened cattle AU	1,774	1,628	1,482	1,226	–31
1,000 or more fattened cattle AU	875	909	906	871	0
All operations	98,390	83,651	64,075	47,154	–52
Potential fattened cattle CAFOs	2,325	2,264	2,155	1,897	–18

See note and footnotes at end of table.

Table A–2 Number of livestock operations with confined animals, 1982–1997—Continued

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
Livestock operations with milk cows					
Less than 25 milk cow AU**	0	0	0	0	---
25 to <50 milk cow AU	55,449	39,838	28,006	17,981	–68
50 to <150 milk cow AU	91,881	81,359	68,130	52,856	–42
150 to <300 milk cow AU	10,392	10,860	10,561	9,680	–7
300 to <1,000 milk cow AU	3,385	3,628	4,022	4,534	34
1,000 or more milk cow AU	456	615	920	1,303	+186
All operations	161,563	136,300	111,639	86,354	–47
Potential milk cow CAFOs	451	609	908	1,296	+187
Livestock operations with other beef and dairy cattle					
Less than 25 cattle AU	112,314	97,170	77,534	68,773	–39
25 to <50 cattle AU	208,152	186,189	175,336	164,983	–21
50 to <150 cattle AU	169,903	155,339	156,604	154,655	–9
150 to <300 cattle AU	34,370	32,783	34,373	36,421	+6
300 to <1,000 cattle AU	16,827	16,621	18,130	19,541	+16
1,000 or more cattle AU	2,524	2,455	2,620	3,008	+19
All operations	544,090	490,557	464,597	447,381	–18
Livestock operations with swine					
Less than 25 swine AU	99,077	76,557	54,947	22,697	–77
25 to <50 swine AU	38,548	32,954	27,469	12,949	–66
50 to <150 swine AU	31,394	30,157	29,241	17,206	–45
150 to <300 swine AU	4,730	5,285	6,525	5,726	+21
300 to <1,000 swine AU	1,432	1,931	2,699	4,134	+189
1,000 or more swine AU	103	168	338	1,011	+882
All operations	175,284	147,052	121,219	63,723	–64
Potential swine CAFOs	1,040	1,392	2,269	4,374	+321
Livestock operations with poultry					
Less than 25 poultry AU	37,817	22,653	11,980	8,646	–77
25 to <50 poultry AU	9,562	7,503	5,304	4,512	–53
50 to <150 poultry AU	14,044	14,142	13,422	12,654	–10
150 to <300 poultry AU	3,175	3,909	5,008	6,129	+93
300 to <1,000 poultry AU	1,786	2,333	2,690	3,312	+85
1,000 or more poultry AU	362	530	615	688	+90
All operations	66,746	51,070	39,019	35,941	–46
Potential poultry CAFOs	1,185	1,799	2,563	3,763	+218

* The sum of farms over livestock types will exceed the total number of farms because many farms have more than one livestock type.
** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).
Note: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.

Table A–3 Number of animal units (confined and not confined) on livestock operations by livestock type and farm size, 1982–1997*

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
All livestock types					
Less than 25 total AU	7,311,927	6,406,057	5,727,476	5,407,009	–26
25 to <50 total AU	9,465,723	8,379,402	7,797,699	7,277,610	–23
50 to <150 total AU	29,009,019	25,722,744	23,961,311	21,460,328	–26
150 to <300 total AU	17,142,530	16,352,605	16,483,027	15,967,020	–7
300 to <1,000 total AU	16,912,228	17,061,674	18,603,343	20,271,518	+20
1,000 or more total AU	15,779,144	17,285,205	19,364,252	24,925,729	+58
All operations	95,620,570	91,207,687	91,937,108	95,309,215	0
Potential CAFOs**	11,513,328	13,716,385	16,042,458	21,970,469	+91
Fattened cattle					
Less than 25 fattened cattle AU	1,001,378	849,823	642,174	468,352	–53
25 to <50 fattened cattle AU	484,375	397,416	305,194	234,916	–52
50 to <150 fattened cattle AU	980,684	785,213	610,539	466,213	–52
150 to <300 fattened cattle AU	645,656	537,118	432,966	321,149	–50
300 to <1,000 fattened cattle AU	887,292	821,129	754,280	635,051	–28
1,000 or more fattened cattle AU	5,707,541	6,367,926	6,518,921	7,462,509	31
All operations	9,706,927	9,758,625	9,264,073	9,588,189	–1
Potential fattened cattle CAFOs	6,490,191	7,101,061	7,197,680	8,033,094	+24
Milk cows					
Less than 25 milk cow AU	681,226	437,818	302,395	217,823	–68
25 to <50 milk cow AU	2,135,268	1,548,728	1,091,422	700,203	–67
50 to <150 milk cow AU	7,340,155	6,609,414	5,629,466	4,472,819	–39
150 to <300 milk cow AU	2,083,766	2,182,995	2,143,527	1,977,211	–5
300 to <1,000 milk cow AU	1,638,705	1,772,591	1,984,362	2,286,670	+40
1,000 or more milk cow AU	773,258	1,070,662	1,672,631	2,634,359	+241
All operations	14,652,378	13,622,207	12,823,803	12,289,085	–16
Potential milk cow CAFOs	768,250	1,064,646	1,660,592	2,627,346	+242
Other beef and dairy cattle					
Less than 25 cattle AU	7,925,271	6,863,828	6,095,503	5,791,582	–27
25 to <50 cattle AU	9,385,485	8,436,396	8,090,690	7,721,143	–18
50 to <150 cattle AU	17,107,165	15,717,085	16,053,941	16,140,383	–6
150 to <300 cattle AU	8,799,116	8,450,533	8,899,789	9,511,372	+8
300 to <1,000 cattle AU	10,102,747	9,910,993	10,791,799	11,738,067	+16
1,000 or more cattle AU	6,578,001	6,379,250	6,730,775	7,884,900	+20
All operations	59,897,784	55,758,084	56,662,498	58,787,447	–2
Swine					
Less than 25 swine AU	1,592,382	1,200,769	880,258	380,839	–76
25 to <50 swine AU	1,371,575	1,178,476	991,270	471,382	–66
50 to <150 swine AU	2,549,298	2,486,149	2,460,935	1,505,886	–41
150 to <300 swine AU	949,966	1,066,494	1,330,858	1,198,623	+26
300 to <1,000 swine AU	654,367	891,266	1,291,998	2,113,796	+223
1,000 or more swine AU	213,048	378,343	877,870	2,851,555	+1,238
All operations	7,330,637	7,201,496	7,833,189	8,522,082	+16
Potential swine CAFOs	693,147	1,021,394	1,895,483	4,669,782	+574

See note and footnotes at end of table.

Table A–3 Number of animal units (confined and not confined) on livestock operations by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
Poultry					
Less than 25 poultry AU	127,503	87,080	49,411	36,847	–71
25 to <50 poultry AU	354,457	278,048	197,851	168,752	–52
50 to <150 poultry AU	1,181,391	1,219,965	1,207,921	1,168,926	–1
150 to <300 poultry AU	651,922	800,822	1,025,966	1,264,537	+94
300 to <1,000 poultry AU	881,682	1,194,875	1,354,153	1,650,787	+87
1,000 or more poultry AU	835,889	1,286,484	1,518,243	1,832,563	+119
All operations	4,032,844	4,867,275	5,353,545	6,122,411	+52
Potential poultry CAFOs	1,237,328	1,887,472	2,314,549	3,019,504	+144

* Animal units are for the specified animal type only. The sum of animal units over livestock types for a specific size class will not equal the value for all livestock types.
** The sum of animal units over livestock types will be less than the total for all livestock types because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.
Note: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.

Table A–4 Number of confined animal units on livestock operations by livestock type and farm size, 1982–1997*

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
All livestock types					
Less than 25 total AU	594,633	522,322	397,372	213,395	–64
25 to <50 total AU	1,943,360	1,650,818	1,321,447	916,360	–53
50 to <150 total AU	11,541,927	10,170,286	8,738,482	6,599,352	–43
150 to <300 total AU	6,873,725	6,731,711	6,721,739	6,069,409	–12
300 to <1,000 total AU	5,989,492	6,442,824	7,182,037	8,150,968	+36
1,000 or more total AU	8,543,885	10,180,675	11,749,709	16,093,217	+88
All operations	35,487,021	35,698,636	36,110,787	38,042,702	+7
Potential CAFOs**	9,293,887	11,202,639	13,201,571	18,505,974	+99
Fattened cattle					
Less than 25 fattened cattle AU	612,510	532,108	403,899	293,293	–52
25 to <50 fattened cattle AU	395,978	326,118	250,688	193,302	–51
50 to <150 fattened cattle AU	861,385	691,411	538,568	414,121	–52
150 to <300 fattened cattle AU	643,013	534,868	431,027	319,898	–50
300 to <1,000 fattened cattle AU	887,292	821,129	754,280	635,051	–28
1,000 or more fattened cattle AU	5,707,541	6,367,926	6,518,921	7,462,509	+31
All operations	9,107,719	9,273,561	8,897,383	9,318,175	+2
Potential fattened cattle CAFOs	6,490,191	7,101,061	7,197,680	8,033,094	+24

See note and footnote at end of table.

Table A–4 Number of confined animal units on livestock operations by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	1982	1987	1992	1997	Percent change 1982 to 1997
Milk cows					
less than 25 milk cow AU***	0	0	0	0	---
25 to <50 milk cow AU	1,785,433	1,296,081	914,292	583,013	–67
50 to <150 milk cow AU	6,086,086	5,514,477	4,710,796	3,754,259	–38
150 to <300 milk cow AU	1,635,874	1,721,728	1,694,104	1,590,238	–3
300 to <1,000 milk cow AU	1,281,300	1,391,885	1,563,497	1,835,832	+43
1,000 or more milk cow AU	578,223	827,313	1,321,556	2,135,205	+269
All operations	11,366,916	10,751,485	10,204,245	9,898,546	–13
Potential milk cow CAFOs	574,346	822,504	1,311,522	2,129,633	+271
Other beef and dairy cattle					
Less than 25 cattle AU	320,253	268,401	209,354	166,704	–48
25 to <50 cattle AU	1,105,317	976,717	867,003	748,041	–32
50 to <150 cattle AU	1,677,836	1,573,303	1,571,810	1,493,903	–11
150 to <300 cattle AU	647,880	635,288	683,144	721,624	+11
300 to <1,000 cattle AU	615,890	638,598	745,026	836,548	+36
1,000 or more cattle AU	325,150	326,816	378,015	508,268	+56
All operations	4,692,325	4,419,122	4,454,352	4,475,087	–5
Swine					
Less than 25 swine AU	925,957	717,499	536,974	227,094	–75
25 to <50 swine AU	1,126,348	968,851	809,144	385,083	–66
50 to <150 swine AU	2,432,292	2,375,322	2,361,829	1,459,105	–40
150 to <300 swine AU	948,702	1,065,228	1,328,974	1,196,911	+26
300 to <1,000 swine AU	654,301	891,113	1,291,882	2,113,110	+223
1,000 or more swine AU	213,048	378,343	877,860	2,851,534	+1,238
All operations	6,300,647	6,396,356	7,206,663	8,232,837	+31
Potential swine CAFOs	693,137	1,021,373	1,895,453	4,669,717	+574
Poultry					
less than 25 poultry AU	116,054	79,674	45,226	33,516	–71
25 to <50 poultry AU	353,784	277,362	197,387	168,326	–52
50 to <150 poultry AU	1,180,227	1,218,944	1,207,232	1,168,382	–1
150 to <300 poultry AU	651,816	800,782	1,025,906	1,264,537	+94
300 to <1,000 poultry AU	881,644	1,194,866	1,354,152	1,650,785	+87
1,000 or more poultry AU	835,889	1,286,484	1,518,242	1,832,509	+119
All operations	4,019,413	4,858,112	5,348,144	6,118,056	+52
Potential poultry CAFOs	1,237,327	1,887,471	2,314,548	3,019,450	+144

* Animal units are for the specified animal type only. The sum of animal units over livestock types for a specific size class will not equal the value for all livestock types.

** The sum of animal units over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

*** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).

Note: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.

Appendix B
Selected Variables by State for 1997

Table B–1 Number of livestock operations and animal units by state, 1997

State	Livestock operations	Animal units on livestock farms	Livestock operations with confined livestock	Confined animal units	Confined livestock operations with 300 or more total animal units	Livestock operations with 300 or more confined animal units	Operations with confined fattened cattle	Confined fattened cattle animal units
Alabama	28,932	1,630,537	3,687	418,415	359	164	176	2,582
Alaska	111	8,127	50	1,992	d	d	d	d
Arizona	2,608	753,458	1,633	319,264	406	116	40	124,907
Arkansas	31,269	2,192,097	19,033	922,633	1,077	505	321	5,813
California	16,393	4,797,122	10,131	2,611,051	3,125	1,877	246	276,331
Colorado	14,830	2,817,542	9,989	1,202,376	1,429	284	565	851,113
Connecticut	1,094	80,787	491	59,523	56	37	18	222
Delaware	1,167	117,518	1,018	106,519	50	d	d	d
Florida	15,043	1,704,825	937	213,580	243	151	0	0
Georgia	23,277	1,585,442	4,505	644,154	661	431	154	3,106
Hawaii	767	159,240	398	26,652	70	19	17	3,497
Idaho	11,170	1,635,573	1,364	626,083	449	340	281	220,618
Illinois	27,083	1,830,284	16,321	1,021,271	888	590	3,796	126,826
Indiana	24,938	1,514,471	13,147	930,917	791	610	2,196	49,166
Iowa	47,119	4,816,189	37,023	2,970,050	2,677	1,763	8,998	512,253
Kansas	36,121	5,222,277	25,187	2,313,788	1,890	444	1,646	1,843,567
Kentucky	47,045	2,073,284	23,957	401,199	506	99	687	14,555
Louisiana	14,219	828,808	1,079	107,695	126	28	49	962
Maine	1,755	119,618	892	78,096	55	26	25	609
Maryland	5,186	375,041	3,226	251,548	156	77	188	3,749
Massachusetts	1,289	64,797	604	39,309	29	15	d	d
Michigan	14,999	1,095,276	8,154	730,717	697	464	1,554	63,888
Minnesota	34,426	3,183,264	24,658	2,262,880	1,486	1,110	4,812	167,513
Mississippi	19,665	1,197,946	11,276	398,822	509	145	158	2,587
Missouri	66,888	4,169,868	40,048	1,213,852	1,600	539	1,844	58,398
Montana	13,861	2,391,564	10,520	100,612	2,232	60	234	33,336
Nebraska	31,135	5,848,213	24,948	2,592,030	3,405	931	4,214	1,699,158
Nevada	1,571	448,188	1,102	62,284	328	35	36	10,752
N. Hampshire	845	43,987	360	26,633	22	d	d	d
New Jersey	1,475	63,267	583	36,002	24	14	34	506
New Mexico	7,964	1,416,525	323	401,862	160	137	76	103,227
New York	15,654	1,474,200	10,694	950,763	776	467	255	7,313
N. Carolina	24,933	2,865,728	6,055	2,166,091	1,842	1,645	148	4,420
North Dakota	14,415	1,555,980	1,974	131,117	194	42	635	27,173
Ohio	28,587	1,465,170	14,292	850,990	625	426	2,526	56,302
Oklahoma	56,508	4,105,614	2,757	742,197	351	147	542	332,952
Oregon	15,295	1,303,686	6,478	208,704	1,006	97	179	51,922
Pennsylvania	26,030	1,903,967	16,629	1,217,654	852	538	1,826	51,195
Rhode Island	195	6,151	85	3,451	d	d	d	d

d Denotes data withheld because of disclosure criteria.

Table B–1 Number of livestock operations and animal units by state, 1997—Continued

State	Livestock operations	Animal units on livestock farms	Livestock operations with confined livestock	Confined animal units	Confined livestock operations with 300 or more total animal units	Livestock operations with 300 or more confined animal units	Operations with confined fattened cattle	Confined fattened cattle animal units
S. Carolina	10,029	586,632	1,203	239,501	301	226	84	2,815
South Dakota	21,134	3,202,478	17,926	771,881	2,554	297	2,171	181,887
Tennessee	49,240	1,817,147	21,471	315,985	449	68	402	6,529
Texas	138,087	11,772,200	71,801	3,330,279	5,017	793	1,084	2,119,899
Utah	7,413	854,117	4,739	253,716	644	188	251	25,404
Vermont	2,983	318,279	2,160	245,189	178	127	19	1,028
Virginia	26,334	1,637,185	14,576	566,309	878	369	505	13,582
Washington	10,709	1,146,944	4,920	520,525	748	376	137	137,690
West Virginia	11,608	411,588	808	93,735	127	73	138	3,326
Wisconsin	39,122	3,312,104	29,409	2,207,751	1,161	633	3,693	66,698
Wyoming	6,210	1,384,912	5,037	135,053	1,300	36	162	45,478
All states	1,048,731	95,309,215	529,658	38,042,702	44,518	17,619	47,154	9,318,175

State	Operations with confined milk cows	Confined milk cow animal units	Operations with confined other beef and dairy	Confined other beef and dairy animal units	Operations with confined swine	Confined swine animal units	Operations with confined poultry	Confined poultry animal units
Alabama	175	14,428	182	1,283	284	20,816	3,096	379,305
Alaska	11	1,303	39	329	d	d	d	d
Arizona	113	135,730	1,582	39,312	d	d	d	d
Arkansas	617	31,795	16,254	117,970	495	125,331	4,923	641,716
California	2,106	1,545,575	9,342	364,875	235	27,630	616	396,635
Colorado	299	86,220	9,701	103,923	253	118,535	96	42,591
Connecticut	239	33,956	361	7,942	22	450	102	16,952
Delaware	102	10,077	159	2,184	47	4,566	842	86,875
Florida	256	109,078	244	10,392	227	3,811	458	90,306
Georgia	511	93,134	481	9,802	819	71,243	3,089	466,868
Hawaii	13	7,436	313	9,177	75	3,240	20	3,301
Idaho	952	346,459	902	52,218	102	2,919	44	d
Illinois	1,735	137,987	11,259	83,130	5,804	636,311	307	37,016
Indiana	1,843	101,094	8,038	51,699	4,949	538,076	674	190,874
Iowa	3,324	257,737	25,255	208,260	16,335	1,839,985	671	151,828
Kansas	871	92,831	24,104	157,253	1,758	200,011	251	20,120
Kentucky	2,129	133,536	22,885	132,986	787	71,064	412	49,051
Louisiana	573	43,691	547	3,650	62	2,383	410	57,003
Maine	493	43,979	719	9,114	27	569	110	23,826
Maryland	891	92,809	1,957	23,577	199	9,955	1,135	121,458
Massachusetts	307	28,773	434	5,395	77	1,693	95	3,167
Michigan	3,164	365,103	6,302	94,115	1,264	141,495	377	66,123
Minnesota	8,573	660,124	18,331	241,943	6,155	811,773	815	381,525
Mississippi	406	36,723	10,138	75,933	174	47,036	1,671	236,545

d Denotes data withheld because of disclosure criteria.

Table B–1 Number of livestock operations and animal units by state, 1997—Continued

State	Operations with confined milk cows	Confined milk cow animal units	Operations with confined other beef and dairy	Confined other beef and dairy animal units	Operations with confined swine	Confined swine animal units	Operations with confined poultry	Confined poultry animal units
Missouri	2,448	148,215	37,623	290,623	3,476	458,671	1,275	257,939
Montana	155	17,498	10,385	26,192	222	21,984	99	1,598
Nebraska	854	72,400	22,026	297,167	5,159	457,689	337	65,614
Nevada	36	27,140	1,083	23,692	d	d	12	7
N. Hampshire	214	21,160	281	3,878	18	416	58	1,121
New Jersey	205	19,485	426	4,492	52	2,549	119	d
New Mexico	162	251,964	169	41,194	38	549	40	d
New York	7,637	765,239	9,894	148,410	201	9,116	305	20,686
N. Carolina	571	62,491	519	4,706	1,924	1,433,278	3,688	661,202
North Dakota	861	57,358	727	7,510	453	21,713	124	17,356
Ohio	3,585	306,611	10,035	89,666	3,392	219,309	1,020	179,096
Oklahoma	789	74,680	708	10,147	520	229,108	963	95,318
Oregon	444	70,417	6,224	64,146	120	3,204	134	19,016
Pennsylvania	9,432	674,726	13,804	122,717	1,310	141,342	1,700	227,680
Rhode Island	31	2,437	47	353	18	323	21	307
S. Carolina	155	19,451	141	3,324	378	38,923	635	174,990
South Dakota	1,289	102,630	16,861	275,042	2,431	177,180	203	35,146
Tennessee	1,125	89,128	20,422	127,355	663	39,635	768	53,340
Texas	1,628	377,295	70,275	435,517	759	74,413	1,511	323,161
Utah	603	101,461	4,560	48,034	91	41,128	112	37,688
Vermont	1,720	200,663	2,026	42,050	17	231	65	1,217
Virginia	1,125	98,503	13,577	112,014	251	50,577	1,274	291,627
Washington	865	271,218	4,648	73,250	118	4,369	159	34,000
West Virginia	215	18,864	200	2,955	49	1,396	436	67,188
Wisconsin	20,446	1,631,691	26,191	347,411	1,834	91,354	604	70,584
Wyoming	56	6,227	5,000	66,792	38	16,541	33	13
All states	86,354	9,898,546	447,381	4,475,087	63,723	8,232,837	35,941	6,118,056

Table B–2 Manure nutrient production on livestock operations by state, 1997

State	All animals on farms			Confined animals on farm			Pounds of recoverable manure nitrogen available for application	Pounds of recoverable manure phosphorus available for application	Pounds of farm-level excess nitrogen	Pounds of farm-level excess phosphorus
	Tons of manure as excreted	Pounds of manure nitrogen as excreted	Pounds of manure phosphorus as excreted	Tons of manure as excreted	Pounds of manure nitrogen as excreted	Pounds of manure phosphorus as excreted				
Alabama	19,953,459	294,931,035	91,812,278	5,824,865	151,749,984	45,215,998	88,530,793	37,553,907	73,100,187	31,422,239
Alaska	98,541	998,592	285,597	26,775	287,525	60,363	105,750	50,071	10,443	7,643
Arizona	9,179,933	94,496,044	26,243,452	3,888,525	43,267,633	10,381,384	15,893,322	8,356,777	13,706,874	7,854,309
Arkansas	26,105,216	407,001,174	129,879,603	11,129,533	257,164,642	81,522,070	138,202,988	67,684,848	102,761,059	50,379,489
California	61,802,058	692,413,196	178,308,742	34,450,533	435,993,694	106,115,817	190,091,487	88,088,189	134,283,685	73,786,783
Colorado	31,755,091	333,327,897	102,984,472	12,168,227	150,234,558	45,051,558	54,511,380	35,336,718	42,369,281	30,129,134
Connecticut	1,068,741	13,822,663	3,729,224	793,346	11,359,696	3,062,312	5,775,541	2,561,568	3,405,069	1,671,091
Delaware	1,686,832	38,679,888	11,089,368	1,516,191	37,371,721	10,740,110	21,341,236	8,912,996	14,644,243	7,227,241
Florida	20,521,352	230,609,163	70,845,116	2,926,624	50,200,083	13,802,592	26,793,674	11,519,750	20,681,526	9,239,115
Georgia	19,937,498	314,574,421	95,160,314	8,766,914	202,780,459	59,481,594	113,890,442	49,394,538	95,250,231	42,386,609
Hawaii	1,866,525	19,735,735	6,213,540	318,463	4,069,115	1,164,612	1,687,755	961,113	1,228,417	640,495
Idaho	19,933,506	201,847,562	55,618,710	7,966,846	87,460,189	19,377,954	33,472,019	15,684,794	19,386,990	12,156,031
Illinois	21,821,309	238,836,659	70,640,882	11,814,706	144,545,061	41,353,705	43,643,938	33,505,281	11,128,012	11,803,392
Indiana	17,920,446	223,808,494	68,614,004	10,470,265	154,278,324	48,361,835	58,971,130	39,644,809	29,703,024	22,784,475
Iowa	57,356,117	640,886,851	192,748,608	34,177,723	429,182,735	126,471,324	133,273,599	102,205,989	40,690,095	42,252,858
Kansas	58,586,280	602,539,518	185,285,141	23,134,027	278,999,452	83,918,650	97,560,061	65,171,823	72,840,086	52,468,008
Kentucky	24,665,734	262,628,335	80,202,109	5,099,696	66,099,294	17,640,310	26,730,740	14,616,765	9,339,592	5,319,779
Louisiana	10,004,065	116,413,893	35,682,477	1,522,104	29,545,569	8,040,927	15,981,121	6,693,032	11,585,140	4,850,279
Maine	1,572,191	20,040,981	5,396,868	1,030,890	15,084,218	4,128,253	7,664,338	3,451,978	4,530,009	2,227,250
Maryland	5,062,105	79,560,648	21,796,382	3,482,166	64,973,547	17,740,814	34,427,368	14,757,498	19,625,550	10,360,621
Massachusetts	880,436	9,392,153	2,145,893	546,842	6,295,087	1,364,090	2,623,812	1,141,749	687,881	391,815
Michigan	13,993,621	152,221,670	38,912,516	9,358,065	111,250,480	27,377,210	42,837,815	22,597,784	10,274,312	8,701,243
Minnesota	38,878,083	466,404,079	134,041,447	27,028,891	362,911,963	103,683,857	137,051,117	85,276,181	59,040,973	46,481,429
Mississippi	14,744,517	208,470,697	63,972,796	5,348,651	113,847,464	33,453,968	61,185,977	27,766,578	48,751,780	21,310,484
Missouri	48,743,596	551,169,335	174,121,482	13,989,348	204,718,739	63,416,589	80,059,784	52,237,026	43,886,779	30,034,486
Montana	27,508,371	280,490,246	91,182,482	1,144,821	13,204,277	3,723,503	4,421,810	3,002,051	694,081	606,099
Nebraska	66,016,138	695,027,090	217,183,318	26,445,847	324,548,303	99,146,735	112,119,762	77,949,397	52,223,570	48,527,630
Nevada	5,261,458	53,786,209	16,801,486	783,841	8,376,868	2,034,292	2,986,168	1,675,471	1,136,618	768,745
N. Hampshire	606,110	6,249,234	1,352,590	378,778	4,152,251	830,761	1,678,157	697,045	266,209	152,271
New Jersey	818,989	9,962,433	2,721,921	476,094	6,695,511	1,803,541	3,270,903	1,505,075	1,820,724	920,936
New Mexico	17,270,812	175,129,226	49,215,794	5,293,562	57,633,449	12,281,196	22,407,774	10,040,981	15,862,639	8,242,105
New York	20,555,714	207,272,566	42,761,755	13,552,877	144,315,223	27,925,387	56,993,749	23,435,224	4,168,880	3,313,258

Table B–2 Manure nutrient production on livestock operations by state, 1997—Continued

State	All animals on farms			Confined animals on farm			Pounds of recoverable manure nitrogen available for application	Pounds of recoverable manure phosphorus available for application	Pounds of farm-level excess nitrogen	Pounds of farm-level excess phosphorus
	Tons of manure as excreted	Pounds of manure nitrogen as excreted	Pounds of manure phosphorus as excreted	Tons of manure as excreted	Pounds of manure nitrogen as excreted	Pounds of manure phosphorus as excreted				
N. Carolina	34,251,580	500,834,484	158,836,600	24,992,125	417,823,786	132,784,183	165,848,300	109,027,521	127,952,474	97,969,395
North Dakota	18,051,594	186,280,180	59,104,118	1,585,505	20,356,703	5,335,208	7,995,559	4,370,338	2,208,488	1,844,461
Ohio	18,126,823	218,671,606	62,921,740	10,545,271	147,702,187	41,712,472	64,184,136	34,472,958	27,448,809	18,465,479
Oklahoma	47,290,671	500,814,552	156,704,912	8,083,697	116,021,629	33,992,404	46,431,386	27,265,270	34,921,290	22,482,999
Oregon	15,375,594	159,425,889	48,844,293	2,545,051	31,248,492	8,336,793	12,885,215	6,833,512	6,776,602	3,835,120
Pennsylvania	25,021,710	294,336,855	74,757,392	16,073,564	214,124,103	54,170,072	94,565,379	45,030,521	33,796,025	23,749,510
Rhode Island	81,581	891,118	215,709	47,208	561,956	125,664	236,515	104,980	67,436	39,746
S. Carolina	6,777,436	104,043,878	34,104,260	2,667,641	62,734,015	20,875,688	33,169,234	17,336,141	26,360,750	14,904,238
South Dakota	37,055,085	384,466,481	121,153,439	8,678,344	102,850,049	30,379,965	34,458,202	24,712,755	5,222,343	6,147,105
Tennessee	21,585,742	232,905,684	71,744,849	4,022,365	55,659,370	15,286,921	23,736,321	12,694,358	10,417,131	4,933,152
Texas	135,160,272	1,446,533,637	452,525,246	35,358,486	472,684,317	140,394,429	192,081,845	111,725,992	147,483,719	88,418,620
Utah	10,122,283	109,293,914	32,818,001	3,047,582	39,097,417	10,597,730	15,582,923	8,754,452	7,447,500	5,537,528
Vermont	4,500,761	44,871,322	8,861,863	3,513,186	36,496,101	6,818,813	14,141,885	5,729,232	571,386	676,142
Virginia	19,186,110	250,495,566	79,148,736	6,490,331	124,438,329	39,846,256	61,036,274	33,115,159	42,278,649	24,791,550
Washington	14,342,673	151,152,570	40,097,631	6,670,321	78,377,425	18,514,281	32,210,623	15,148,969	17,235,946	10,781,822
West Virginia	4,810,434	62,302,216	19,955,112	1,117,229	25,219,942	8,010,263	13,633,161	6,661,486	9,300,179	5,095,422
Wisconsin	44,827,301	453,757,958	99,191,321	30,749,007	332,649,616	67,412,993	129,693,909	56,318,365	12,314,182	9,494,480
Wyoming	15,865,969	161,232,483	52,281,118	1,453,665	16,198,259	4,972,011	5,098,864	4,017,434	1,833,137	1,525,274
All states	1,138,608,464	12,905,038,076	3,840,216,707	452,496,613	6,266,840,809	1,760,239,455	2,583,175,242	1,436,796,450	1,472,720,023	929,109,364

Table B–3 Acres and assimilative capacity for all farms (with and without livestock) by state, 1997

State	Total number of farms	Acres of 24 crops used to calculate assimilative capacity	Acres of cropland used for pasture	Acres of permanent pasture available for manure application	Pounds of nitrogen taken up by 24 crops and removed at harvest	Assimilative capacity for pastureland, pounds of nitrogen	Pounds of phosphorus potentially taken up by 24 crops and removed at harvest	Assimilative capacity for pastureland, pounds of phosphorus
Alabama	41,384	2,076,655	1,588,367	520,737	154,684,112	133,708,154	34,645,031	53,379,114
Alaska	548	33,616	7,774	0	1,268,440	583,050	442,600	233,220
Arizona	6,135	827,484	115,900	27,512	172,993,268	9,462,841	15,521,126	3,779,634
Arkansas	45,142	8,246,022	2,008,011	711,001	861,887,391	170,508,842	110,586,356	68,061,337
California	74,126	4,725,258	1,246,009	492,821	893,050,902	107,249,668	93,870,782	42,801,303
Colorado	28,268	5,576,256	700,536	468,755	565,360,916	65,665,345	72,286,180	26,172,387
Connecticut	3,687	122,635	27,414	9,475	13,931,178	2,321,350	2,487,461	926,645
Delaware	2,460	522,912	10,691	2,790	66,207,098	879,945	6,721,652	351,420
Florida	34,799	668,710	895,684	1,090,225	60,174,646	97,702,612	13,338,308	38,863,000
Georgia	40,334	3,655,135	1,083,321	406,493	267,392,926	92,630,879	38,935,640	36,971,053
Hawaii	5,473	2,045	41,834	48,302	363,914	4,490,010	31,928	1,786,344
Idaho	22,314	4,113,879	816,471	364,589	680,042,500	71,443,830	73,302,963	28,504,614
Illinois	73,051	22,620,654	825,653	337,606	3,915,806,692	71,376,943	385,335,342	28,483,256
Indiana	57,916	11,854,472	621,266	181,400	1,976,931,896	51,674,150	196,361,204	20,633,380
Iowa	90,792	23,602,739	2,001,198	720,314	4,357,242,658	170,258,628	423,464,344	67,959,389
Kansas	61,593	20,291,926	3,434,056	748,386	2,105,231,592	278,509,006	270,239,831	111,253,925
Kentucky	82,273	5,097,455	3,101,480	563,756	552,722,403	248,396,154	93,504,868	99,245,711
Louisiana	23,823	3,512,451	840,581	398,450	350,967,187	74,200,176	45,611,166	29,600,381
Maine	5,810	371,138	65,066	13,417	31,802,906	5,255,612	6,119,752	2,099,562
Maryland	12,084	1,512,693	148,667	48,230	174,439,703	12,500,465	19,989,953	4,990,540
Massachusetts	5,574	132,659	39,471	12,092	13,425,006	3,298,887	2,695,730	1,317,137
Michigan	46,027	6,182,274	481,259	93,666	886,735,184	38,717,059	89,422,885	15,468,091
Minnesota	73,367	18,679,291	998,431	473,080	2,719,111,301	88,128,551	273,094,288	35,156,805
Mississippi	31,318	4,438,304	1,124,094	462,712	470,970,995	97,262,972	59,641,929	38,812,647
Missouri	98,860	12,804,669	5,247,558	1,833,704	1,544,807,992	444,910,559	211,148,160	177,597,483
Montana	24,279	9,412,084	1,607,455	1,508,097	690,908,143	162,785,847	83,847,580	64,812,719
Nebraska	51,454	17,487,739	1,840,068	746,238	2,440,149,990	158,899,767	285,825,144	63,410,659
Nevada	2,829	512,383	259,875	106,681	96,135,747	22,477,703	10,529,061	8,969,745
N. Hampshire	2,937	96,434	21,932	7,171	9,120,676	1,845,674	1,937,086	736,836
New Jersey	9,101	394,299	64,364	17,253	46,424,051	5,310,384	6,118,647	2,120,703
New Mexico	14,094	1,016,457	586,490	90,410	140,252,431	46,518,236	14,165,643	18,589,212
New York	31,757	3,547,312	632,596	236,724	402,308,104	54,072,958	56,151,676	21,581,839
N. Carolina	49,406	4,626,958	882,844	183,465	439,989,986	71,350,306	52,870,609	28,503,430
North Dakota	30,504	18,354,297	1,433,612	467,751	1,125,796,586	120,617,930	136,275,482	48,153,622
Ohio	68,591	9,974,242	847,865	287,156	1,638,918,499	71,630,229	165,261,423	28,594,661
Oklahoma	74,214	8,575,308	4,980,365	2,212,227	511,932,440	435,469,743	96,229,769	173,745,452
Oregon	34,030	2,215,357	909,186	613,858	288,634,496	85,376,981	41,250,274	34,028,021
Pennsylvania	45,457	4,106,794	680,759	184,297	471,759,735	56,217,227	63,769,177	22,450,032
Rhode Island	735	12,066	4,730	1,331	1,319,271	392,004	253,479	156,536
S. Carolina	20,189	1,807,280	508,887	120,252	151,122,495	41,533,581	21,030,472	16,589,382
South Dakota	31,284	13,714,519	2,302,552	874,023	1,460,399,665	197,164,050	158,029,701	78,690,815
Tennessee	76,818	4,298,389	2,445,224	492,049	410,649,683	197,169,158	75,269,580	78,769,254
Texas	194,301	19,369,517	11,919,691	4,441,498	1,238,682,740	1,018,338,765	244,151,265	406,447,207
Utah	14,181	1,087,826	558,120	296,492	201,491,142	50,160,776	18,808,705	20,005,012
Vermont	5,828	492,742	131,686	41,890	52,185,629	11,049,370	8,391,755	4,411,370
Virginia	41,095	2,695,518	1,519,882	536,868	241,153,690	129,023,440	45,474,845	51,502,003
Washington	29,011	3,983,131	503,514	294,084	539,789,641	45,997,900	65,956,387	18,340,343
West Virginia	17,772	616,573	657,775	264,535	42,951,779	56,740,091	12,924,941	22,643,130
Wisconsin	65,602	8,770,684	959,426	353,288	1,334,044,120	81,849,014	134,825,509	32,668,948
Wyoming	9,232	1,734,468	736,852	528,031	173,329,996	70,048,773	24,150,496	27,913,903
All states	1,911,859	300,573,703	64,466,542	24,935,177	36,987,003,540	5,533,175,596	4,362,298,184	2,208,283,203

Appendix C
Number of Livestock Operations and Animal Units According to Enterprise Type and Farm Size, 1997

Table C–1 Profile of livestock types on farms classified by enterprise type and farm size, 1997 (includes confined animals and animals not held in confinement)

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
Fattened cattle dominant							
>75% of total animal units on farm	6,369	8,386,885	6,995,112	38	4,008	25	1,387,703
0 to 650 head fattened cattle capacity	5,233	145,226	125,370	35	408	24	19,388
650 to 1,300 head fattened cattle capacity	251	99,543	82,018	1	724	0	16,799
1,300 to 11,000 head fattened cattle capacity	531	885,765	737,751	0	2,824	0	145,190
11,000 or more head fattened cattle capacity	354	7,256,352	6,049,972	1	52	0	1,206,326
50–75% of total animal units on farm	16,219	2,219,767	1,447,002	3,811	41,087	970	726,897
0 to 650 head fattened cattle capacity	15,200	590,670	375,964	227	18,584	592	195,304
650 to 1,300 head fattened cattle capacity	536	261,321	168,883	69	10,180	249	81,940
1,300 to 11,000 head fattened cattle capacity	439	688,189	449,699	407	12,323	129	225,631
11,000 or more head fattened cattle capacity	44	679,587	452,456	3,108	0	0	224,023
Milk cows dominant							
>75% of total animal units on farm	28,396	5,568,191	3,846	4,641,370	1,546	510	920,918
0 to 350 head milk cow capacity	26,639	3,057,887	2,629	2,523,269	1,288	459	530,242
350 to 700 head milk cow capacity	981	753,328	231	634,905	237	51	117,904
700 or more head milk cow capacity	776	1,756,976	986	1,483,196	22	1	272,772
50–75% of total animal units on farm	59,738	10,480,995	58,114	6,927,030	33,172	10,411	3,452,269
0 to 350 head milk cow capacity	58,164	7,751,489	53,041	5,077,150	31,962	8,555	2,580,781
350 to 700 head milk cow capacity	919	869,161	2,688	588,909	758	1,584	275,220
700 or more head milk cow capacity	655	1,860,346	2,385	1,260,970	452	271	596,267
Other beef and dairy cattle dominant							
>75% of total animal units on farm	817,643	49,687,850	401,552	67,369	126,303	20,921	49,071,705
50–75% of total animal units on farm	34,043	3,281,300	445,301	365,400	313,851	128,438	2,028,309
Swine dominant							
>75% of total AU							
Grow-finish farms	16,199	2,462,529	5,648	1,536	2,400,716	12,330	42,298
0 to 750 head hogs-on-feed capacity	9,226	179,231	695	80	175,570	80	2,806
750 to 1,875 head hogs-on-feed capacity	3,116	257,317	1,011	116	250,978	95	5,118
1,875 to 2,500 head hogs-on-feed capacity	753	112,159	539	57	108,994	84	2,486
2,500 to 5,000 head hogs-on-feed capacity	1,439	347,488	1,314	355	336,607	508	8,703
5,000 or more head hogs-on-feed capacity	1,665	1,566,333	2,089	928	1,528,567	11,563	23,186
Farrowing farms	297	24,564	12	1	23,960	1	590
Farrow-finish farms	26,881	4,722,107	11,682	2,601	4,631,783	4,942	71,099
0 to 750 head swine capacity	15,523	371,443	1,521	341	361,125	224	8,232
750 to 1,875 head swine capacity	6,032	679,456	3,275	280	658,991	294	16,616
1,875 to 2,500 head swine capacity	1,388	272,402	1,241	96	264,449	9	6,606
2,500 to 5,000 head swine capacity	2,129	664,519	3,045	422	645,636	881	14,535
5,000 or more head swine capacity	1,809	2,734,288	2,599	1,464	2,701,582	3,533	25,110

Table C–1 Profile of livestock types on farms classified by enterprise type and farm size, 1997 (includes confined animals and animals not held in confinement)—Continued

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
50-75% of total animal units on farm	8,576	1,046,402	58,457	20,977	648,661	52,595	265,712
0 to 750 head swine capacity	5,325	191,053	9,485	2,968	115,782	1,360	61,458
750 to 1,875 head swine capacity	2,098	310,635	18,680	4,785	190,395	2,788	93,987
1,875 to 2,500 head swine capacity	389	97,492	6,481	2,247	61,082	1,116	26,566
2,500 to 5,000 head swine capacity	502	191,654	12,363	4,812	120,360	5,846	48,272
5,000 or more head swine capacity	262	255,568	11,449	6,165	161,042	41,484	35,428
Layers and pullets dominant							
>75% of total animal units on farm							
Pullets only	1,092	133,181	294	73	433	127,747	4,634
0 to 30,000 head pullet capacity	570	25,279	20	5	26	23,969	1,258
30,000 to 60,000 head pullet capacity	286	30,100	7	3	78	28,591	1,420
60,000 to180,000 head pullet capacity	185	40,935	201	65	110	39,067	1,492
180,000 or more head pullet capacity	51	36,868	65	0	218	36,120	464
Layers only	4,041	701,744	588	2,257	1,863	678,914	18,122
0 to 30,000 head layer capacity	3,057	142,054	54	58	164	135,621	6,157
30,000 to 60,000 head layer capacity	400	70,774	224	66	174	66,856	3,454
60,000 to180,000 head layer capacity	406	164,019	310	403	1,000	158,839	3,466
180,000 or more head layer capacity	178	324,898	1	1,730	524	317,598	5,044
Layers and pullets mixed	470	481,328	148	86	300	478,653	2,140
0 to 30,000 head layer-pullet capacity	219	2,148	1	0	6	2,086	56
30,000 to 60,000 head layer-pullet capacity	32	4,724	0	0	4	4,488	231
60,000 to 180,000 head layer-pullet capacity	71	22,814	76	19	74	22,110	535
180,000 or more head layer-pullet capacity	148	451,642	71	68	217	449,969	1,318
50-75% of total animal units on farm	1,252	199,612	2,515	6,147	8,874	133,656	48,420
0 to 30,000 head layer-pullet capacity	941	71,117	344	482	996	45,105	24,191
30,000 to 60,000 head layer-pullet capacity	202	40,568	438	727	876	26,804	11,723
60,000 to 180,000 head layer-pullet capacity	93	43,555	1,065	2,632	3,364	29,929	6,566
180,000 or more head layer-pullet capacity	16	44,372	669	2,305	3,639	31,819	5,939
Broilers dominant							
>75% of total animal units on farm	13,501	2,077,745	614	731	1,729	1,967,952	106,720
0 to 30,000 head broiler capacity	1,382	37,556	16	19	26	36,575	920
30,000 to 60,000 head broiler capacity	2,272	142,203	65	49	182	135,887	6,021
60,000 to 90,000 head broiler capacity	2,300	216,785	45	86	215	205,166	11,273
90,000 to 180,000 head broiler capacity	4,682	691,417	235	232	742	650,887	39,321
180,000 or more head broiler capacity	2,865	989,784	253	345	564	939,438	49,185
50-75% of total animal units on farm	3,292	625,056	1,366	4,846	3,808	402,109	212,927
0 to 30,000 head broiler capacity	343	16,245	67	115	118	9,995	5,951
30,000 to 60,000 head broiler capacity	655	62,469	134	477	560	38,720	22,579
60,000 to 90,000 head broiler capacity	673	90,495	196	512	275	57,158	32,354
90,000 to 180,000 head broiler capacity	1,119	234,334	699	2,066	1,149	149,974	80,445
180,000 or more head broiler capacity	502	221,513	270	1,676	1,706	146,263	71,598

Table C–1 Profile of livestock types on farms classified by enterprise type and farm size, 1997 (includes confined animals and animals not held in confinement)—Continued

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
Turkeys dominant							
>75% of total animal units on farm	3,034	1,981,513	1,021	2,261	4,345	1,918,188	55,698
0 to 16,500 head turkey capacity	1,202	227,804	264	369	876	216,487	9,808
16,500 to 38,500 head turkey capacity	1,123	562,706	336	901	1,969	537,302	22,198
38,500 to 55,000 head turkey capacity	339	290,345	205	543	549	279,569	9,479
55,000 or more head turkey capacity	370	900,658	216	447	951	884,831	14,212
50–75% of total animal units on farm	347	183,847	1,111	5,549	26,388	124,078	26,722
0 to 16,500 head turkey capacity	209	47,368	491	2,088	2,757	30,770	11,262
16,500 to 38,500 head turkey capacity	105	71,923	473	2,219	10,059	48,127	11,046
38,500 to 55,000 head turkey capacity	19	27,982	19	518	7,170	18,103	2,173
55,000 or more head turkey capacity	14	36,574	128	724	6,402	27,078	2,241
Mixed, no dominant livestock type	7,341	1,044,597	153,806	237,001	249,254	59,972	344,564
Total	1,048,731	95,309,215	9,588,189	12,289,085	8,522,082	6,122,411	58,787,447

Note: Each farm is uniquely assigned to one of 19 enterprise types based on the mix of animal units on the farm and the dominant animal type on the farm. Confined animals and animals not held in confinement were used to derive the dominant animal type. Two categories of farms were derived:

- Farms where the dominant type comprises 75 percent or more of the animal units on the farm.
- Farms where the dominant type comprises 50 to 75 percent of the animal units on the farm.

Grow-finish farms are farms where hogs for slaughter are at least 95 percent of the swine animal units on the farm. *Farrowing farms* are farms where hogs for breeding are at least 95 percent of the swine animal units. *Farrow-finish farms* are the remaining farms that have a mix of hogs for slaughter and breeding hogs that together comprise at least 75 percent of the animal units on the farm. *Pullet only farms* are farms where pullets are at least 95 percent of the pullet and layer animal units on the farm. *Layer only farms* are farms where layers are at least 95 percent of the pullet and layer animal units. *Layer and pullet mixed farms* are the remaining farms that have a mix of layers and pullets that together comprise at least 75 percent of the animal units on the farm.

Each farm is also assigned to a size class based on the estimated farm capacity for the dominant animal type. Fattened cattle capacity was based on total sales. Milk cow capacity was based on end-of-year inventory. Hogs on feed capacity for grow-finish farms was based on hogs-for-slaughter inventory plus sales per cycle, with 2.8 cycles. Swine capacity included breeding hog inventory, with 2.1 cycles. Breeding swine capacity was based on end-of-year inventory of breeding hogs. Pullet capacity, layer capacity, and pullet-layer capacity were based on end-of-year inventory. If the inventory was zero, capacity was based on pullet and layer sales per cycle, with 2.25 cycles. Broiler capacity was based on end-of-year inventory plus sales per cycle, with 5.5 cycles. Turkey capacity was based on inventory of turkeys for breeding plus sales of turkeys for slaughter per cycle, with 2.8 cycles.

Table C–2 Profile of livestock types on farms with **confined** livestock, classified by enterprise type and farm size, 1997*

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
Fattened cattle dominant							
>75% of total animal units on farm	3,764	7,060,136	6,978,925	0	3,600	10	77,602
0 to 650 head fattened cattle capacity	2,628	110,916	109,183	0	197	10	1,526
650 to 1,300 head fattened cattle capacity	251	84,241	82,018	0	665	0	1,557
1,300 to 11,000 head fattened cattle capacity	531	751,809	737,751	0	2,702	0	11,356
11,000 or more head fattened cattle capacity	354	6,113,171	6,049,972	0	37	0	63,162
50–75% of total animal units on farm	9,505	1,493,585	1,395,813	3,200	37,528	927	56,117
0 to 650 head fattened cattle capacity	8,486	356,987	324,775	151	15,407	549	16,104
650 to 1300 head fattened cattle capacity	536	186,170	168,883	55	9,883	249	7,099
1,300 to 11,000 head fattened cattle capacity	439	478,609	449,699	298	12,237	129	16,247
11,000 or more head fattened cattle capacity	44	471,818	452,456	2,696	0	0	16,667
Milk cows dominant							
>75% of total animal units on farm	25,973	4,100,029	2,579	3,715,359	665	420	381,007
0 to 350 head milk cow capacity	24,216	2,204,964	1,514	2,013,101	473	370	189,506
350 to 700 head milk cow capacity	981	562,004	197	504,192	192	50	57,374
700 or more head milk cow capacity	776	1,333,061	868	1,198,066	0	0	134,127
50–75% of total animal units on farm	54,091	7,050,411	43,127	5,683,241	24,147	10,155	1,289,741
0 to 350 head milk cow capacity	52,517	5,185,412	38,590	4,180,552	22,982	8,301	934,987
350 to 700 head milk cow capacity	919	593,249	2,253	477,274	729	1,584	111,410
700 or more head milk cow capacity	655	1,271,750	2,283	1,025,416	436	271	243,344
Other beef and dairy cattle dominant							
>75% of total animal units on farm	338,050	2,778,849	298,347	26,965	78,481	18,818	2,356,238
50–75% of total animal units on farm	21,299	1,234,130	398,354	249,513	265,597	128,109	192,557
Swine dominant							
>75% of total AU							
Grow-finish farms	13,607	2,382,356	4,040	965	2,362,890	12,290	2,171
0 to 750 head hogs-on-feed capacity	6,634	139,799	214	0	139,487	48	50
750 to 1,875 head hogs-on-feed capacity	3,116	250,286	632	26	249,325	91	212
1,875 to 2,500 head hogs-on-feed capacity	753	109,597	379	32	108,954	83	148
2,500 to 5,000 head hogs-on-feed capacity	1,439	338,803	930	218	336,574	506	575
5,000 or more head hogs-on-feed capacity	1,665	1,543,871	1,885	688	1,528,551	11,562	1,185
Farrowing farms	245	23,652	11	0	23,621	0	20
Farrow-finish farms	23,245	4,560,289	8,121	1,567	4,541,747	4,817	4,037
0 to 750 head swine capacity	11,887	287,845	513	0	287,030	146	157
750 to 1,875 head swine capacity	6,032	646,916	2,215	50	643,602	270	779
1,875 to 2,500 head swine capacity	1,388	265,495	867	48	264,133	8	438
2,500 to 5,000 head swine capacity	2,129	650,089	2,321	312	645,422	880	1,155
5,000 or more head swine capacity	1,809	2,709,944	2,205	1,158	2,701,560	3,513	1,508

Table C–2 Profile of livestock types on farms with **confined** livestock, classified by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
50-75% of total animal units on farm	7,268	756,454	47,529	14,976	618,656	52,449	22,845
0 to 750 head swine capacity	4,017	101,569	6,106	372	90,870	1,300	2,921
750 to 1,875 head swine capacity	2,098	214,835	14,309	3,734	185,359	2,710	8,723
1,875 to 2,500 head swine capacity	389	72,112	5,296	1,906	61,037	1,113	2,759
2,500 to 5,000 head swine capacity	502	146,056	10,765	4,054	120,347	5,846	5,044
5,000 or more head swine capacity	262	221,883	11,054	4,909	161,042	41,480	3,398
Layers and pullets dominant							
>75% of total animal units on farm							
Pullets only	1,082	128,513	234	44	377	127,745	113
0 to 30,000 head pullet capacity	560	23,998	5	0	19	23,967	7
30,000 to 60,000 head pullet capacity	286	28,675	0	0	50	28,591	34
60,000 to180,000 head pullet capacity	185	39,431	171	44	92	39,067	57
180,000 or more head pullet capacity	51	36,408	58	0	215	36,120	15
Layers only	3,857	683,547	493	1,771	1,651	678,889	744
0 to 30,000 head layer capacity	2,873	135,761	17	0	86	135,595	63
30,000 to 60,000 head layer capacity	400	67,343	199	39	149	66,856	101
60,000 to180,000 head layer capacity	406	160,532	277	320	923	158,839	173
180,000 or more head layer capacity	178	319,911	0	1,412	493	317,598	407
Layers and pullets mixed	437	479,186	132	55	268	478,642	89
0 to 30,000 head layer-pullet capacity	186	2,077	0	0	2	2,075	0
30,000 to 60,000 head layer-pullet capacity	32	4,495	0	0	0	4,488	6
60,000 to 180,000 head layer-pullet capacity	71	22,273	72	0	63	22,110	29
180,000 or more head layer-pullet capacity	148	450,341	60	55	204	449,969	54
50–75% of total animal units on farm	1,229	151,708	2,408	4,170	8,591	133,643	2,897
0 to 30,000 head layer-pullet capacity	918	47,226	275	162	812	45,091	886
30,000 to 60,000 head layer-pullet capacity	202	29,360	425	602	807	26,804	722
60,000 to 180,000 head layer-pullet capacity	93	36,838	1,044	1,978	3,333	29,929	555
180,000 or more head layer-pullet capacity	16	38,283	664	1,428	3,639	31,819	734
Broilers dominant							
>75% of total animal units on farm	13,469	1,972,843	392	253	1,049	1,967,947	3,203
0 to 30,000 head broiler capacity	1,350	36,587	6	0	0	36,571	10
30,000 to 60,000 head broiler capacity	2,272	136,074	37	0	92	135,886	60
60,000 to 90,000 head broiler capacity	2,300	205,506	19	20	122	205,166	180
90,000 to 180,000 head broiler capacity	4,682	652,665	153	53	433	650,886	1,141
180,000 or more head broiler capacity	2,865	942,011	179	180	402	939,438	1,812
50–75% of total animal units on farm	3,285	420,156	1,113	2,943	3,450	402,098	10,552
0 to 30,000 head broiler capacity	336	10,265	39	0	71	9,987	168
30,000 to 60,000 head broiler capacity	655	40,485	93	187	460	38,717	1,028
60,000 to 90,000 head broiler capacity	673	59,499	143	308	234	57,158	1,656
90,000 to 180,000 head broiler capacity	1,119	157,227	596	1,429	1,042	149,974	4,185
180,000 or more head broiler capacity	502	152,681	242	1,019	1,643	146,263	3,515

Table C–2 Profile of livestock types on farms with **confined** livestock, classified by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	Livestock operations	Animal units on farms					
		All types	Fattened cattle	Dairy cows	Swine	Poultry	Other beef and dairy
Turkeys dominant							
>75% of total animal units on farm	2,997	1,927,619	838	1,543	4,119	1,917,387	3,733
0 to 16,500 head turkey capacity	1,165	217,514	195	198	784	215,741	596
16,500 to 38,500 head turkey capacity	1,123	541,506	255	648	1,871	537,300	1,431
38,500 to 55,000 head turkey capacity	339	281,379	185	399	529	279,569	697
55,000 or more head turkey capacity	370	887,221	202	298	935	884,777	1,008
50–75% of total animal units on farm	332	157,862	951	3,897	26,293	123,970	2,751
0 to 16,500 head turkey capacity	194	36,303	403	1,444	2,688	30,662	1,105
16,500 to 38,500 head turkey capacity	105	61,301	405	1,505	10,035	48,127	1,229
38,500 to 55,000 head turkey capacity	19	25,897	15	388	7,170	18,103	222
55,000 or more head turkey capacity	14	34,361	128	560	6,400	27,078	195
Mixed, no dominant livestock type	5,923	681,375	134,769	188,083	230,110	59,741	68,672
Total	529,658	38,042,702	9,318,175	9,898,546	8,232,837	6,118,056	4,475,087

* See footnote to table C-1 for explanation of enterprise types and farm capacity estimates.

Appendix D
Manure Nutrient Production by Livestock Type and Farm Size, 1982–1997

Table D–1 Manure nitrogen as excreted for all livestock by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	878.3	765.8	680.4	635.9	–28
25 to <50 total AU	1,207.9	1,058.9	970.4	892.6	–26
50 to <150 total AU	3,913.7	3,496.1	3,247.7	2,888.2	–26
150 to <300 total AU	2,288.2	2,229.5	2,304.7	2,293.9	0
300 to <1,000 total AU	2,215.1	2,293.5	2,540.4	2,843.9	+28
1,000 or more total AU	1,994.3	2,259.4	2,569.5	3,350.5	+68
All operations	12,497.5	12,103.3	12,313.0	12,905.0	+3
Potential CAFOs**	1,573.5	1,966.3	2,373.3	3,333.2	+112
Fattened cattle					
Less than 25 fattened cattle AU	116.4	98.8	74.7	54.5	–53
25 to <50 fattened cattle AU	56.3	46.2	35.5	27.3	–52
50 to <150 fattened cattle AU	114.0	91.3	71.0	54.2	–52
150 to <300 fattened cattle AU	75.1	62.5	50.3	37.3	–50
300 to <1,000 fattened cattle AU	103.2	95.5	87.7	73.8	–28
1,000 or more fattened cattle AU	663.7	740.5	758.0	867.7	+31
All operations	1,128.7	1,134.7	1,077.2	1,114.9	–1
Potential fattened cattle CAFOs	754.7	825.7	836.9	934.1	+24
Milk cows					
Less than 25 milk cow AU	111.0	71.3	49.3	35.5	–68
25 to <50 milk cow AU	347.9	252.3	177.8	114.1	–67
50 to <150 milk cow AU	1,195.8	1,076.8	917.1	728.7	–39
150 to <300 milk cow AU	339.5	355.6	349.2	322.1	–5
300 to <1,000 milk cow AU	267.0	288.8	323.3	372.5	+40
1,000 or more milk cow AU	126.0	174.4	272.5	429.2	+241
All operations	2,387.1	2,219.3	2,089.2	2,002.1	–16
Potential milk cow CAFOs	125.2	173.4	270.5	428.0	+242
Other beef and dairy cattle					
Less than 25 cattle AU	863.5	754.0	676.2	648.8	–25
25 to <50 cattle AU	1,028.5	927.8	898.2	866.9	–16
50 to <150 cattle AU	1,920.9	1,759.7	1,805.3	1,826.8	–5
150 to <300 cattle AU	1,002.3	959.3	1,010.7	1,082.0	+8
300 to <1,000 cattle AU	1,153.6	1,127.4	1,223.9	1,328.4	+15
1,000 or more cattle AU	739.5	711.9	744.7	864.3	+17
All operations	6,708.3	6,240.0	6,359.0	6,617.1	–1

See footnotes and notes at end of table.

Table D–1 Manure nitrogen as excreted for all livestock by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Swine					
Less than 25 swine AU	211.1	158.3	119.6	52.5	–75
25 to <50 swine AU	187.2	159.9	137.7	67.2	–64
50 to <150 swine AU	351.5	340.3	341.1	213.8	–39
150 to <300 swine AU	129.4	145.2	183.3	170.4	+32
300 to <1,000 swine AU	88.8	120.7	178.3	303.0	+241
1,000 or more swine AU	28.9	52.1	120.4	390.6	+1,252
All operations	996.9	976.6	1,080.6	1,197.5	+20
Potential swine CAFOs	96.4	142.1	265.2	660.8	+586
Poultry					
Less than 25 poultry AU	43.1	29.9	16.8	12.6	–71
25 to <50 poultry AU	126.0	98.8	69.8	59.3	–53
50 to <150 poultry AU	425.4	448.3	451.2	436.1	+3
150 to <300 poultry AU	206.4	265.0	360.6	462.0	+124
300 to <1,000 poultry AU	242.7	331.6	385.3	487.8	+101
1,000 or more poultry AU	233.0	359.2	423.5	515.7	+121
All operations	1,276.5	1,532.7	1,707.1	1,973.5	+55
Potential poultry CAFOs	359.7	554.7	700.0	943.1	+162

* Pounds of manure nitrogen are for the specified animal type only and do not include pounds of manure nitrogen from other animal types on the farms.

** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement. The sum over livestock types for a specific size class will not equal the value for all livestock types.

Table D–2 Manure nitrogen as excreted for confined livestock by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	87.4	74.9	56.2	31.0	–65
25 to <50 total AU	317.4	264.3	206.9	145.2	–54
50 to <150 total AU	1,878.0	1,685.6	1,473.0	1,156.0	–38
150 to <300 total AU	1,091.5	1,109.9	1,168.7	1,142.5	+5
300 to <1,000 total AU	946.0	1,060.5	1,213.4	1,437.7	+52
1,000 or more total AU	1,172.9	1,455.8	1,710.1	2,354.4	+101
All operations	5,493.1	5,651.0	5,828.3	6,266.8	+14
Potential CAFOs**	1,336.3	1,696.1	2,065.9	2,954.0	+121
Fattened cattle					
Less than 25 fattened cattle AU	71.2	61.9	47.0	34.1	–52
25 to <50 fattened cattle AU	46.0	37.9	29.1	22.5	–51
50 to <150 fattened cattle AU	100.2	80.4	62.6	48.2	–52
150 to <300 fattened cattle AU	74.8	62.2	50.1	37.2	–50
300 to <1,000 fattened cattle AU	103.2	95.5	87.7	73.8	–28
1,000 or more fattened cattle AU	663.7	740.5	758.0	867.7	+31
All operations	1,059.0	1,078.3	1,034.6	1,083.5	+2
Potential fattened cattle CAFOs	754.7	825.7	836.9	934.1	+24
Milk cows					
Less than 25 milk cow AU***	0.0	0.0	0.0	0.0	---
25 to <50 milk cow AU	290.9	211.2	149.0	95.0	–67
50 to <150 milk cow AU	991.5	898.4	767.5	611.6	–38
150 to <300 milk cow AU	266.5	280.5	276.0	259.1	–3
300 to <1,000 milk cow AU	208.7	226.8	254.7	299.1	+43
1,000 or more milk cow AU	94.2	134.8	215.3	347.9	+269
All operations	1,851.8	1,751.6	1,662.4	1,612.6	–13
Potential milk cow CAFOs	93.6	134.0	213.7	347.0	+271
Other beef and dairy cattle					
Less than 25 cattle AU	25.5	21.5	16.9	13.7	–46
25 to <50 cattle AU	100.7	89.3	81.0	71.9	–29
50 to <150 cattle AU	164.7	152.5	153.6	148.6	–10
150 to <300 cattle AU	67.4	65.1	69.8	74.0	+10
300 to <1,000 cattle AU	65.2	66.3	76.0	84.6	+30
1,000 or more cattle AU	34.4	34.3	38.5	50.1	+46
All operations	458.0	429.1	435.9	443.1	–3
Swine					
Less than 25 swine AU	120.7	92.5	71.9	31.1	–74
25 to <50 swine AU	151.2	129.2	110.8	54.3	–64
50 to <150 swine AU	332.8	322.5	325.3	206.3	–38
150 to <300 swine AU	129.2	145.0	183.0	170.1	+32
300 to <1,000 swine AU	88.8	120.7	178.3	302.9	+241
1,000 or more swine AU	28.9	52.1	120.4	390.6	+1,252
All operations	851.6	862.0	989.8	1,155.4	+36
Potential swine CAFOs	96.4	142.1	265.2	660.8	+586

See footnotes and notes at end of table.

Table D–2 Manure nitrogen as excreted for confined livestock by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Poultry					
Less than 25 poultry AU	39.7	27.7	15.5	11.6	–71
25 to <50 poultry AU	125.8	98.6	69.6	59.2	–53
50 to <150 poultry AU	425.1	448.1	451.0	435.9	+3
150 to <300 poultry AU	206.4	265.0	360.6	462.0	+124
300 to <1,000 poultry AU	242.6	331.6	385.3	487.8	+101
1,000 or more poultry AU	233.0	359.2	423.5	515.6	+121
All operations	1,272.6	1,530.1	1,705.6	1,972.2	+55
Potential poultry CAFOs	359.7	554.7	700.0	943.1	+162

* Pounds of manure nitrogen are for the specified animal type only and do not include pounds of manure nitrogen from other animal types on the farms.

** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

*** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).

Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.
The sum over livestock types for a specific size class will not equal the value for all livestock types.

Table D–3 Recoverable manure nitrogen (available for application) by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	30.2	25.4	17.8	10.7	–65
25 to <50 total AU	124.2	101.4	76.2	55.5	–55
50 to <150 total AU	750.8	680.1	595.6	485.1	–35
150 to <300 total AU	436.3	453.6	488.3	501.3	+15
300 to <1,000 total AU	388.1	444.4	506.4	599.1	+54
1,000 or more total AU	475.2	605.2	705.6	931.5	+96
All operations	2,204.7	2,310.0	2,389.9	2,583.2	+17
Potential CAFOs**	556.3	725.8	878.7	1,210.7	+118
Fattened cattle					
Less than 25 fattened cattle AU	25.6	22.3	16.9	12.3	–52
25 to <50 fattened cattle AU	16.6	13.6	10.5	8.1	–51
50 to <150 fattened cattle AU	36.0	28.9	22.5	17.3	–52
150 to <300 fattened cattle AU	26.9	22.4	18.0	13.4	–50
300 to <1,000 fattened cattle AU	37.1	34.4	31.6	26.6	–28
1,000 or more fattened cattle AU	238.8	266.4	272.8	312.2	+31
All operations	381.1	388.0	372.3	389.9	+2
Potential fattened cattle CAFOs	271.6	297.1	301.2	336.1	+24
Milk cows					
Less than 25 milk cow AU***	0.0	0.0	0.0	0.0	---
25 to <50 milk cow AU	114.7	83.2	58.7	37.4	–67
50 to <150 milk cow AU	390.9	354.1	302.5	241.1	–38
150 to <300 milk cow AU	105.1	110.6	108.8	102.1	–3
300 to <1,000 milk cow AU	82.3	89.4	100.4	117.9	+43
1,000 or more milk cow AU	37.1	53.1	84.9	137.1	+269
All operations	730.0	690.5	655.3	635.7	–13
Potential milk cow CAFOs	36.9	52.8	84.2	136.8	+271
Other beef and dairy cattle					
Less than 25 cattle AU	7.5	6.3	5.0	4.0	–46
25 to <50 cattle AU	29.7	26.3	23.9	21.2	–29
50 to <150 cattle AU	48.6	45.0	45.3	43.8	–10
150 to <300 cattle AU	19.9	19.2	20.6	21.8	+10
300 to <1,000 cattle AU	19.2	19.6	22.4	25.0	+30
1,000 or more cattle AU	10.2	10.1	11.3	14.8	+46
All operations	135.0	126.5	128.5	130.6	–3
Swine					
Less than 25 swine AU	28.6	21.9	17.1	7.4	–74
25 to <50 swine AU	35.9	30.6	26.3	12.9	–64
50 to <150 swine AU	79.0	76.5	77.2	48.9	–38
150 to <300 swine AU	30.7	34.4	43.4	40.4	+32
300 to <1,000 swine AU	21.1	28.6	42.3	71.9	+241
1,000 or more swine AU	6.9	12.4	28.6	92.7	+1,252
All operations	202.0	204.5	234.8	274.1	+36
Potential swine CAFOs	22.9	33.7	62.9	156.8	+586

See footnotes and notes at end of table.

Table D–3 Recoverable manure nitrogen (available for application) by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Poultry					
Less than 25 poultry AU	24.3	16.9	9.4	7.0	–71
25 to <50 poultry AU	76.2	59.6	42.1	35.8	–53
50 to <150 poultry AU	254.3	266.3	267.6	258.7	+2
150 to <300 poultry AU	123.9	156.6	211.6	270.4	+118
300 to <1,000 poultry AU	140.3	189.6	219.0	276.8	+97
1,000 or more poultry AU	137.4	211.5	249.3	304.2	+121
All operations	756.6	900.5	999.0	1,152.9	+52
Potential poultry CAFOs	214.7	329.0	413.5	556.5	+159

* Pounds of manure nitrogen are for the specified animal type only and do not include pounds of manure nitrogen from other animal types on the farms.

** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

*** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).

Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.
The sum over livestock types for a specific size class will not equal the value for all livestock types.

Table D–4 Manure phosphorus as excreted for all livestock by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	274.8	241.8	216.2	203.5	–26
25 to <50 total AU	366.6	325.7	303.6	283.5	–23
50 to <150 total AU	1,083.8	975.4	925.1	842.7	–22
150 to <300 total AU	648.7	629.3	657.0	662.4	+2
300 to <1,000 total AU	664.9	688.6	760.4	851.8	+28
1,000 or more total AU	612.5	692.9	776.4	996.2	+63
All operations	3,651.4	3,553.7	3,638.8	3,840.2	+5
Potential CAFOs**	482.8	605.7	717.7	990.8	+105
Fattened cattle					
Less than 25 fattened cattle AU	35.7	30.3	22.9	16.7	–53
25 to <50 fattened cattle AU	17.3	14.2	10.9	8.4	–52
50 to <150 fattened cattle AU	35.0	28.0	21.8	16.6	–52
150 to <300 fattened cattle AU	23.0	19.2	15.5	11.5	–50
300 to <1,000 fattened cattle AU	31.7	29.3	26.9	22.7	–28
1,000 or more fattened cattle AU	203.7	227.3	232.6	266.3	+31
All operations	346.4	348.3	330.6	342.2	–1
Potential fattened cattle CAFOs	231.6	253.4	256.9	286.7	+24
Milk cows					
Less than 25 milk cow AU	19.9	12.8	8.8	6.4	–68
25 to <50 milk cow AU	62.5	45.3	31.9	20.5	–67
50 to <150 milk cow AU	214.8	193.4	164.7	130.9	–39
150 to <300 milk cow AU	61.0	63.9	62.7	57.9	–5
300 to <1,000 milk cow AU	47.9	51.9	58.1	66.9	+40
1,000 or more milk cow AU	22.6	31.3	48.9	77.1	+241
All operations	428.7	398.6	375.2	359.6	–16
Potential milk cow CAFOs	22.5	31.2	48.6	76.9	+242
Other beef and dairy cattle					
Less than 25 cattle AU	270.2	237.3	214.3	206.9	–23
25 to <50 cattle AU	323.6	292.7	285.2	277.5	–14
50 to <150 cattle AU	614.3	561.6	578.1	587.6	–4
150 to <300 cattle AU	323.5	308.8	325.5	348.9	+8
300 to <1,000 cattle AU	372.7	363.2	393.6	426.5	+14
1,000 or more cattle AU	235.7	225.5	234.3	270.0	+15
All operations	2,140.1	1,989.1	2,031.0	2,117.4	–1
Swine					
Less than 25 swine AU	63.1	47.3	35.6	15.6	–75
25 to <50 swine AU	55.7	47.6	40.9	19.9	–64
50 to <150 swine AU	104.5	101.3	101.4	63.3	–39
150 to <300 swine AU	38.5	43.2	54.5	50.5	+31
300 to <1,000 swine AU	26.5	36.0	53.0	89.7	+239
1,000 or more swine AU	8.6	15.5	35.8	116.2	+1,250
All operations	296.9	290.9	321.2	355.2	+20
Potential swine CAFOs	28.6	42.2	78.7	195.8	+584

See footnotes and notes at end of table.

Table D–4 Manure phosphorus as excreted for all livestock by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Poultry					
Less than 25 poultry AU	14.4	9.8	5.5	4.1	–71
25 to <50 poultry AU	40.2	31.5	22.3	19.0	–53
50 to <150 poultry AU	134.0	138.9	138.2	133.6	0
150 to <300 poultry AU	71.3	88.2	114.8	143.0	+101
300 to <1,000 poultry AU	91.5	123.4	140.5	173.0	+89
1,000 or more poultry AU	87.9	135.1	159.4	193.2	+120
All operations	439.3	526.8	580.7	665.9	+52
Potential poultry CAFOs	131.8	201.0	248.1	326.7	+148

* Pounds of manure phosphorus are for the specified animal type only and do not include pounds of manure phosphorus from other animal types on the farms.

** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.
The sum over livestock types for a specific size class will not equal the value for all livestock types.

Table D–5 Manure phosphorus as excreted for confined livestock by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	26.9	22.9	17.1	9.5	–65
25 to <50 total AU	88.7	74.9	59.7	42.5	–52
50 to <150 total AU	459.4	417.2	370.8	294.7	–36
150 to <300 total AU	281.0	285.9	305.8	302.5	+8
300 to <1,000 total AU	267.8	304.0	346.4	411.7	+54
1,000 or more total AU	358.2	447.3	517.4	699.4	+95
All operations	1,482.0	1,552.2	1,617.2	1,760.2	+19
Potential CAFOs**	417.6	531.6	635.5	890.6	+113
Fattened cattle					
Less than 25 fattened cattle AU	21.9	19.0	14.4	10.5	–52
25 to <50 fattened cattle AU	14.1	11.6	8.9	6.9	–51
50 to <150 fattened cattle AU	30.7	24.7	19.2	14.8	–52
150 to <300 fattened cattle AU	22.9	19.1	15.4	11.4	–50
300 to <1,000 fattened cattle AU	31.7	29.3	26.9	22.7	–28
1,000 or more fattened cattle AU	203.7	227.3	232.6	266.3	+31
All operations	325.0	331.0	317.5	332.5	+2
Potential fattened cattle CAFOs	231.6	253.4	256.9	286.7	+24
Milk cows					
Less than 25 milk cow AU***	0.0	0.0	0.0	0.0	---
25 to <50 milk cow AU	52.2	37.9	26.8	17.1	–67
50 to <150 milk cow AU	178.1	161.4	137.8	109.9	–38
150 to <300 milk cow AU	47.9	50.4	49.6	46.5	–3
300 to <1,000 milk cow AU	37.5	40.7	45.7	53.7	+43
1,000 or more milk cow AU	16.9	24.2	38.7	62.5	+269
All operations	332.6	314.6	298.6	289.6	–13
Potential milk cow CAFOs	16.8	24.1	38.4	62.3	+271
Other beef and dairy cattle					
Less than 25 cattle AU	6.0	5.1	4.1	3.4	–44
25 to <50 cattle AU	27.6	24.6	22.7	20.6	–25
50 to <150 cattle AU	48.0	44.0	44.6	43.8	–9
150 to <300 cattle AU	20.5	19.6	21.0	22.3	+9
300 to <1,000 cattle AU	20.1	20.1	22.8	25.2	+26
1,000 or more cattle AU	10.5	10.5	11.4	14.6	+38
All operations	132.8	123.8	126.6	129.9	–2
Swine					
Less than 25 swine AU	36.1	27.7	21.5	9.3	–74
25 to <50 swine AU	45.1	38.6	33.0	16.1	–64
50 to <150 swine AU	99.0	96.1	96.7	61.2	–38
150 to <300 swine AU	38.5	43.2	54.4	50.4	+31
300 to <1,000 swine AU	26.5	36.0	53.0	89.6	+239
1,000 or more swine AU	8.6	15.5	35.8	116.2	+1,250
All operations	253.8	257.0	294.4	342.8	+35
Potential swine CAFOs	28.6	42.2	78.7	195.8	+584

See footnotes and notes at end of table.

Table D–5 Manure phosphorus as excreted for confined livestock by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Poultry					
Less than 25 poultry AU	13.1	9.0	5.1	3.8	–71
25 to <50 poultry AU	40.1	31.4	22.3	19.0	–53
50 to <150 poultry AU	133.9	138.8	138.1	133.5	0
150 to <300 poultry AU	71.3	88.2	114.8	143.0	+101
300 to <1,000 poultry AU	91.5	123.4	140.5	173.0	+89
1,000 or more poultry AU	87.9	135.1	159.4	193.2	+120
All operations	437.8	525.8	580.1	665.4	+52
Potential poultry CAFOs	131.8	201.0	248.1	326.7	+148

* Pounds of manure phosphorus are for the specified animal type only and do not include pounds of manure phosphorus from other animal types on the farms.
** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.
*** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).
Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement.
The sum over livestock types for a specific size class will not equal the value for all livestock types.

Table D–6 Recoverable manure phosphorus (available for application) by livestock type and farm size, 1982–1997*

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
All livestock types					
Less than 25 total AU	21.8	18.5	13.8	7.6	–65
25 to <50 total AU	72.8	61.4	49.0	35.0	–52
50 to <150 total AU	379.6	344.7	306.3	243.9	–36
150 to <300 total AU	231.3	235.7	252.3	250.0	+8
300 to <1,000 total AU	219.4	249.8	285.1	339.1	+55
1,000 or more total AU	283.5	356.0	413.7	561.2	+98
All operations	1,208.4	1,266.1	1,320.1	1,436.8	+19
Potential CAFOs**	331.2	424.4	509.8	717.4	+117
Fattened cattle					
Less than 25 fattened cattle AU	16.7	14.5	11.0	8.0	–52
25 to <50 fattened cattle AU	10.8	8.9	6.8	5.3	–51
50 to <150 fattened cattle AU	23.5	18.8	14.7	11.3	–52
150 to <300 fattened cattle AU	17.5	14.6	11.7	8.7	–50
300 to <1,000 fattened cattle AU	24.2	22.4	20.6	17.3	–28
1,000 or more fattened cattle AU	155.6	173.6	177.7	203.4	+31
All operations	248.3	252.8	242.5	254.0	+2
Potential fattened cattle CAFOs	176.9	193.6	196.2	219.0	+24
Milk cows					
Less than 25 milk cow AU***	0.0	0.0	0.0	0.0	---
25 to <50 milk cow AU	44.0	31.9	22.5	14.4	–67
50 to <150 milk cow AU	150.0	135.9	116.1	92.5	–38
150 to <300 milk cow AU	40.3	42.4	41.7	39.2	–3
300 to <1,000 milk cow AU	31.6	34.3	38.5	45.2	+43
1,000 or more milk cow AU	14.2	20.4	32.6	52.6	+269
All operations	280.1	264.9	251.5	243.9	–13
Potential milk cow CAFOs	14.2	20.3	32.3	52.5	+271
Other beef and dairy cattle					
Less than 25 cattle AU	5.0	4.3	3.4	2.8	–44
25 to <50 cattle AU	23.0	20.4	18.9	17.2	–25
50 to <150 cattle AU	40.0	36.6	37.2	36.5	–9
150 to <300 cattle AU	17.1	16.3	17.5	18.6	+9
300 to <1,000 cattle AU	16.7	16.8	19.0	21.0	+26
1,000 or more cattle AU	8.8	8.7	9.5	12.1	+38
All operations	110.6	103.1	105.5	108.2	–2
Swine					
Less than 25 swine AU	29.2	22.4	17.3	7.5	–74
25 to <50 swine AU	36.4	31.1	26.6	13.0	–64
50 to <150 swine AU	80.0	77.5	78.1	49.4	–38
150 to <300 swine AU	31.1	34.9	43.9	40.7	+31
300 to <1,000 swine AU	21.4	29.0	42.8	72.4	+239
1,000 or more swine AU	6.9	12.5	28.9	93.8	+1,250
All operations	204.9	207.5	237.7	276.8	+35
Potential swine CAFOs	23.1	34.1	63.6	158.2	+584

See footnotes and notes at end of table.

Table D–6 Recoverable manure phosphorus (available for application) by livestock type and farm size, 1982–1997*—Continued

Livestock type and farm size category	Million pounds				Percent change
	1982	1987	1992	1997	1982 to 1997
Poultry					
Less than 25 poultry AU	10.9	7.5	4.2	3.1	–71
25 to <50 poultry AU	33.4	26.1	18.6	15.8	–53
50 to <150 poultry AU	111.4	115.4	114.8	111.0	0
150 to <300 poultry AU	59.3	73.4	95.5	118.8	+100
300 to <1,000 poultry AU	76.3	102.8	117.0	144.1	+89
1,000 or more poultry AU	73.3	112.6	132.9	161.0	+120
All operations	364.6	437.8	482.9	553.9	+52
Potential poultry CAFOs	109.8	167.5	206.7	272.1	+148

* Pounds of manure phosphorus are for the specified animal type only and do not include pounds of manure phosphorus from other animal types on the farms.

** The sum over livestock types will be less than the total because the total includes livestock on the farm other than the livestock type qualifying the farm as a potential CAFO.

*** There are no confined milk cows in this smallest farm size class by assumption. The threshold for the number of head below which all milk cows were assumed to not be confined was 20, which converts to more than 25 milk cow animal units (see table 2).

Notes: Size classes are based on all animal units (AU) on farms, including both confined animals and animals not held in confinement. The sum over livestock types for a specific size class will not equal the value for all livestock types.

Appendix E
Manure Nutrient Production According to Enterprise Type and Farm Size, 1997

Table E–1 Manure nitrogen production by enterprise type and farm size, 1997*

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess nitrogen (assuming no off-farm export of manure)			
	Manure nitrogen produced, pounds as excreted**	Manure nitrogen available for application, pounds	Number of operations	Excess manure nitrogen, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
Fattened cattle dominant						
>75% of total animal units on farm	948,427,165	294,353,770	902	241,774,056	313	431
0 to 650 head fattened cattle capacity	16,544,489	4,621,310	366	626,404	16	216
650 to 1,300 head fattened cattle capacity	11,285,061	3,501,987	40	440,829	68	17
1,300 to 11,000 head fattened cattle capacity	100,325,592	31,291,915	171	10,297,512	298	59
11,000 or more head fattened cattle capacity	820,272,023	254,938,558	325	230,409,311	592	139
50–75% of total animal units on farm	247,664,371	61,731,901	885	23,139,303	81	456
0 to 650 head fattened cattle capacity	66,014,838	14,720,212	666	960,787	16	379
650 to 1,300 head fattened cattle capacity	29,454,448	7,682,299	58	687,886	89	24
1,300 to 11,000 head fattened cattle capacity	76,851,313	19,776,186	127	6,005,482	218	44
11,000 or more head fattened cattle capacity	75,343,771	19,553,203	34	15,485,149	369	9
Milk cows dominant						
>75% of total animal units on farm	831,033,470	247,102,062	3,951	75,713,767	82	933
0 to 350 head milk cow capacity	454,441,619	133,565,853	2,893	13,990,316	50	627
350 to 700 head milk cow capacity	112,957,340	33,653,336	491	13,157,012	111	133
700 or more head milk cow capacity	263,634,511	79,882,872	567	48,566,440	236	173
50–75% of total animal units on farm	1,436,786,712	398,364,516	2,935	46,528,457	77	696
0 to 350 head milk cow capacity	1,060,628,076	293,468,799	2,376	10,217,193	52	529
350 to 700 head milk cow capacity	120,208,501	33,553,476	232	6,293,849	130	57
700 or more head milk cow capacity	255,950,135	71,342,241	327	30,017,415	247	110
Other beef and dairy cattle dominant						
>75% of total animal units on farm	5,767,648,676	101,496,109	19,661	5,479,403	9	13,990
50-75% of total animal units on farm	428,298,081	75,268,843	1,971	13,860,849	127	540
Swine dominant						
>75% of total AU						
Grow-finish farms	399,974,305	93,570,483	4,312	49,427,943	50	2,469
0 to 750 head hogs-on-feed capacity	29,225,271	5,456,476	1,720	1,289,051	6	1,241
750 to 1,875 head hogs-on-feed capacity	41,817,699	9,741,195	763	2,242,154	14	483
1,875 to 2,500 head hogs-on-feed capacity	18,149,395	4,254,071	228	1,140,973	24	124
2,500 to 5,000 head hogs-on-feed capacity	56,665,350	13,287,500	536	4,381,063	36	256
5,000 or more head hogs-on-feed capacity	254,116,590	60,831,241	1,065	40,374,700	103	365

See footnotes at end of table.

Table E–1 Manure nitrogen production by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess nitrogen (assuming no off-farm export of manure)			
	Manure nitrogen produced, pounds as excreted**	Manure nitrogen available for application, pounds	Number of operations	Excess manure nitrogen, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
Farrowing farms	2,012,378	456,485	83	253,072	25	56
Farrow-finish farms	607,710,896	139,877,846	5,510	64,977,373	58	3,575
0 to 750 head swine capacity	45,557,589	8,165,614	2,803	1,396,750	5	2,018
750 to 1,875 head swine capacity	86,991,439	19,663,612	939	2,943,003	22	578
1,875 to 2,500 head swine capacity	35,167,218	8,170,093	275	1,576,268	29	166
2,500 to 5,000 head swine capacity	86,034,731	20,188,211	558	4,998,028	44	295
5,000 or more head swine capacity	353,959,920	83,690,316	935	54,063,323	206	518
50–75% of total animal units on farm	147,789,871	32,995,471	672	6,866,828	74	237
0 to 750 head swine capacity	24,429,376	3,479,615	403	349,263	9	187
750 to 1,875 head swine capacity	41,226,195	7,834,418	103	472,574	32	32
1,875 to 2,500 head swine capacity	13,248,071	2,734,334	28	213,592	92	4
2,500 to 5,000 head swine capacity	27,213,693	6,167,909	51	1,078,583	94	9
5,000 or more head swine capacity	41,672,536	12,779,195	87	4,752,816	263	5
Layers and pullets dominant						
>75% of total animal units on farm						
Pullets only	29,660,532	14,298,997	956	11,212,535	42	420
0 to 30,000 head pullet capacity	5,609,325	2,697,210	495	2,089,437	24	230
30,000 to 60,000 head pullet capacity	6,654,499	3,178,588	252	2,378,723	39	95
60,000 to180,000 head pullet capacity	9,096,652	4,384,682	159	3,146,667	74	68
180,000 or more head pullet capacity	8,300,056	4,038,517	50	3,597,707	154	27
Layers only	212,114,397	140,777,875	3,453	124,257,542	61	1,508
0 to 30,000 head layer capacity	42,532,318	28,046,799	2,523	23,534,213	32	1,113
30,000 to 60,000 head layer capacity	21,070,642	13,861,480	373	11,457,955	71	132
60,000 to180,000 head layer capacity	49,634,212	32,962,454	381	27,269,509	138	170
180,000 or more head layer capacity	98,877,224	65,907,142	176	61,995,865	336	93
Layers and pullets mixed	144,399,899	95,020,451	377	89,233,320	234	233
0 to 30,000 head layer-pullet capacity	611,457	384,026	136	331,049	9	98
30,000 to 60,000 head layer-pullet capacity	1,338,871	844,062	30	699,793	83	14
60,000 to 180,000 head layer-pullet capacity	6,577,397	4,207,467	67	3,607,214	132	36
180,000 or more head layer-pullet capacity	135,872,174	89,584,895	144	84,595,265	472	85
50–75% of total animal units on farm	47,242,938	25,634,755	948	13,903,035	107	76
0 to 30,000 head layer-pullet capacity	16,411,665	8,670,964	700	4,660,969	61	59
30,000 to 60,000 head layer-pullet capacity	9,253,707	4,767,374	165	2,462,015	136	11
60,000 to 180,000 head layer-pullet capacity	10,390,635	5,660,008	69	2,977,662	241	6
180,000 or more head layer-pullet capacity	11,186,931	6,536,409	14	3,802,387	1,282	0

See footnotes at end of table.

Table E–1 Manure nitrogen production by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess nitrogen (assuming no off-farm export of manure)			
	Manure nitrogen produced, pounds as excreted**	Manure nitrogen available for application, pounds	Number of operations	Excess manure nitrogen, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
Broilers dominant						
>75% of total animal units on farm	802,868,398	464,836,725	12,742	412,550,148	57	4,718
0 to 30,000 head broiler capacity	14,798,473	8,638,165	1,189	7,203,891	23	680
30,000 to 60,000 head broiler capacity	55,311,269	32,101,535	2,127	27,454,886	32	911
60,000 to 90,000 head broiler capacity	83,765,927	48,470,477	2,190	42,391,339	42	870
90,000 to 180,000 head broiler capacity	266,189,871	153,799,994	4,475	134,235,022	58	1,471
180,000 or more head broiler capacity	382,802,858	221,826,554	2,761	201,265,011	89	786
50–75% of total animal units on farm	187,347,348	95,329,934	3,037	63,874,198	129	101
0 to 30,000 head broiler capacity	4,730,481	2,356,064	272	1,424,866	40	30
30,000 to 60,000 head broiler capacity	18,325,236	9,184,645	600	5,798,887	69	20
60,000 to 90,000 head broiler capacity	26,840,240	13,542,243	628	8,917,655	93	19
90,000 to 180,000 head broiler capacity	70,147,968	35,656,447	1,051	23,376,400	140	23
180,000 or more head broiler capacity	67,303,424	34,590,535	486	24,356,391	270	9
Turkeys dominant						
>75% of total animal units on farm	479,321,732	245,998,014	2,714	214,868,540	126	931
0 to 16,500 head turkey capacity	53,757,743	27,144,875	983	21,262,718	66	371
16,500 to 38,500 head turkey capacity	135,688,491	69,324,145	1,047	57,152,724	122	313
38,500 to 55,000 head turkey capacity	70,473,316	36,175,432	325	31,522,751	154	103
55,000 or more head turkey capacity	219,402,182	113,353,562	359	104,930,346	285	144
50–75% of total animal units on farm	39,212,898	17,817,761	241	10,286,686	224	27
0 to 16,500 head turkey capacity	9,653,418	4,169,541	129	1,851,429	158	15
16,500 to 38,500 head turkey capacity	15,396,130	6,942,855	87	4,580,020	277	9
38,500 to 55,000 head turkey capacity	5,931,395	2,664,969	14	1,343,155	379	2
55,000 or more head turkey capacity	8,231,955	4,040,395	11	2,512,083	375	1
Mixed, no dominant livestock type	145,524,010	38,243,244	401	4,512,970	135	77
Total	12,905,038,076	2,583,175,242	65,751	1,472,720,023	73	31,474

* Each farm is uniquely assigned to one of 19 enterprise types based on the mix of animal units on the farm and the dominant animal type on the farm. Confined animals and animals not held in confinement were used to derive the dominant animal type. Two categories of farms were derived:
- Farms where the dominant type comprises 75 percent or more of the animal units on the farm
- Farms where the dominant type comprises 50 to 75 percent of the animal units on the farm.

Grow-finish farms are farms where hogs for slaughter are at least 95 percent of the swine animal units on the farm. *Farrowing farms* are farms where hogs for breeding are at least 95 percent of the swine animal units. *Farrow-finish farms* are the remaining farms that have a mix of hogs for slaughter and breeding hogs that together comprise at least 75 percent of the animal units on the farm. *Pullet only farms* are farms where pullets are at least 95 percent of the pullet and layer animal units on the farm. *Layer only farms* are farms where layers are at least 95 percent of the pullet and layer animal units. *Layer and pullet mixed farms* are the remaining farms that have a mix of layers and pullets that together comprise at least 75 percent of the animal units. Each farm is assigned to a size class based on the estimated farm capacity for the dominant animal type. Fattened cattle capacity was based on total sales. Milk cow capacity was based on end-of-year inventory. Hogs on feed capacity for grow-finish farms was based on hogs-for-slaughter inventory plus sales per cycle, with 2.8 cycles. Swine capacity included breeding hog inventory, with 2.1 cycles. Breeding swine capacity was based on end-of-year inventory of breeding hogs. Pullet capacity, layer capacity, and pullet-layer capacity were based on end-of-year inventory. If the inventory was zero, capacity was based on pullet and layer sales per cycle, with 2.25 cycles. Broiler capacity was based on end-of-year inventory plus sales per cycle, with 5.5 cycles. Turkey capacity was based on inventory of turkeys for breeding plus sales of turkeys for slaughter per cycle, with 2.8 cycles.

** Includes all animals on the farm, both confined and not confined.

*** Acres per farm are based on 24 crops and pastureland on farms with acres. Farms without acres were not included in the calculation.

Table E–2 Manure phosphorus production by enterprise type and farm size, 1997*

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess phosphorus (assuming no off-farm export of manure)			
	Manure phosphorus produced, pounds as excreted**	Manure phosphorus available for application, pounds	Number of operations	Excess manure phosphorus, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
Fattened cattle dominant						
>75% of total animal units on farm	286,842,972	192,088,709	1,333	175,494,002	547	431
0 to 650 head fattened cattle capacity	5,019,892	3,018,228	473	493,118	39	216
650 to 1,300 head fattened cattle capacity	3,411,068	2,295,867	94	505,704	239	17
1,300 to 11,000 head fattened cattle capacity	30,353,825	20,461,915	414	12,891,540	779	59
11,000 or more head fattened cattle capacity	248,058,187	166,312,699	352	161,603,640	886	139
50–75% of total animal units on farm	74,192,230	40,813,907	1,456	20,391,952	271	456
0 to 650 head fattened cattle capacity	19,722,894	9,826,637	985	884,389	53	379
650 to 1,300 head fattened cattle capacity	8,848,102	5,150,159	158	860,678	357	24
1,300 to 11,000 head fattened cattle capacity	23,079,127	13,098,227	270	6,800,818	668	44
11,000 or more head fattened cattle capacity	22,542,108	12,738,883	43	11,846,068	1,181	9
Milk cows dominant						
>75% of total animal units on farm	153,719,134	96,760,033	7,468	40,349,362	143	933
0 to 350 head milk cow capacity	84,239,279	52,234,907	6,036	8,632,882	106	627
350 to 700 head milk cow capacity	20,842,679	13,205,247	729	7,154,866	248	133
700 or more head milk cow capacity	48,637,177	31,319,878	703	24,561,614	403	173
50–75% of total animal units on farm	280,880,348	160,921,260	8,117	31,400,334	178	696
0 to 350 head milk cow capacity	208,064,972	118,752,375	7,066	8,334,135	133	529
350 to 700 head milk cow capacity	23,370,351	13,523,545	503	4,665,338	372	57
700 or more head milk cow capacity	49,445,026	28,645,339	548	18,400,861	652	110
Other beef and dairy cattle dominant						
>75% of total animal units on farm	1,879,224,971	87,690,619	24,336	5,829,459	19	13,990
50-75% of total animal units on farm	125,799,598	42,906,802	2,611	8,448,195	152	540
Swine dominant						
>75% of total AU						
Grow-finish farms	116,992,892	91,923,726	6,295	63,676,414	161	2,469
0 to 750 head hogs-on-feed capacity	8,521,773	5,414,342	2,206	1,572,038	21	1,241
750 to 1,875 head hogs-on-feed capacity	12,203,983	9,661,796	1,217	3,091,022	80	483
1,875 to 2,500 head hogs-on-feed capacity	5,301,248	4,213,297	385	1,637,635	143	124
2,500 to 5,000 head hogs-on-feed capacity	16,546,052	13,121,686	965	6,676,825	196	256
5,000 or more head hogs-on-feed capacity	74,419,835	59,512,604	1,522	50,698,894	311	365
Farrowing farms	649,618	497,391	115	342,790	43	56
Farrow-finish farms	182,445,703	142,100,374	9,116	86,062,104	192	3,575
0 to 750 head swine capacity	13,745,857	8,381,992	3,877	1,952,790	22	2,018
750 to 1,875 head swine capacity	26,125,757	19,999,882	1,919	4,772,213	106	578
1,875 to 2,500 head swine capacity	10,554,556	8,309,089	603	2,569,205	178	166
2,500 to 5,000 head swine capacity	25,810,681	20,407,681	1,189	8,240,989	241	295
5,000 or more head swine capacity	106,208,851	85,001,730	1,528	68,526,907	582	518

See footnotes at end of table.

Table E–2 Manure phosphorus production by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess phosphorus (assuming no off-farm export of manure)			
	Manure phosphorus produced, pounds as excreted**	Manure phosphorus available for application, pounds	Number of operations	Excess manure phosphorus, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
50–75% of total animal units on farm	45,020,220	27,921,296	1,591	8,604,701	194	237
0 to 750 head swine capacity	7,375,813	3,263,691	762	425,588	28	187
750 to 1,875 head swine capacity	12,444,581	7,193,111	370	799,127	125	32
1,875 to 2,500 head swine capacity	3,962,305	2,463,480	94	328,677	216	4
2500 to 5,000 head swine capacity	8,139,775	5,265,987	186	1,370,268	299	9
5,000 or more head swine capacity	13,097,746	9,735,027	179	5,681,041	757	5
Layers and pullets dominant						
>75% of total animal units on farm						
Pullets only	11,421,597	9,368,662	1,042	8,394,243	67	420
0 to 30,000 head pullet capacity	2,158,714	1,758,700	527	1,499,271	33	230
30,000 to 60,000 head pullet capacity	2,563,328	2,090,167	281	1,771,633	74	95
60,000 to180,000 head pullet capacity	3,500,465	2,869,734	183	2,557,907	125	68
180,000 or more head pullet capacity	3,199,090	2,650,062	51	2,565,431	162	27
Layers only	78,398,982	64,868,092	3,589	60,959,558	86	1,508
0 to 30,000 head layer capacity	15,727,030	12,927,541	2,609	11,317,443	40	1,113
30,000 to 60,000 head layer capacity	7,784,985	6,389,979	396	5,726,741	118	132
60,000 to180,000 head layer capacity	18,340,583	15,199,257	406	14,179,884	237	170
180,000 or more head layer capacity	36,546,384	30,351,315	178	29,735,490	367	93
Layers and pullets mixed	53,649,689	44,703,244	387	43,815,854	280	233
0 to 30,000 head layer-pullet capacity	228,013	187,337	137	164,642	9	98
30,000 to 60,000 head layer-pullet capacity	498,382	408,299	32	367,217	95	14
60,000 to 180,000 head layer-pullet capacity	2,447,244	2,025,561	70	1,885,358	173	36
180,000 or more head layer-pullet capacity	50,476,049	42,082,047	148	41,398,637	559	85
50–75% of total animal units on farm	16,943,279	12,622,472	1,071	9,054,435	130	76
0 to 30,000 head layer-pullet capacity	5,949,147	4,192,305	777	2,549,341	71	59
30,000 to 60,000 head layer-pullet capacity	3,328,283	2,417,694	187	1,539,035	163	11
60,000 to 180,000 head layer-pullet capacity	3,675,322	2,860,371	91	2,230,373	330	6
180,000 or more head layer-pullet capacity	3,990,527	3,152,102	16	2,735,686	1,321	0
Broilers dominant						
>75% of total animal units on farm	233,983,130	190,981,358	13,162	175,236,651	81	4,718
0 to 30,000 head broiler capacity	4,304,031	3,546,717	1,221	3,038,828	30	680
30,000 to 60,000 head broiler capacity	16,103,398	13,182,760	2,206	11,701,241	44	911
60,000 to 90,000 head broiler capacity	24,400,432	19,906,003	2,252	17,908,064	56	870
90,000 to 180,000 head broiler capacity	77,559,927	63,175,980	4,637	57,327,834	86	1,471
180,000 or more head broiler capacity	111,615,341	91,169,898	2,846	85,260,684	127	786

See footnotes at end of table.

Table E–2 Manure phosphorus production by enterprise type and farm size, 1997*—Continued

Enterprise type and farm capacity of dominant animal type	All operations		Operations with farm-level excess phosphorus (assuming no off-farm export of manure)			
	Manure phosphorus produced, pounds as excreted**	Manure phosphorus available for application, pounds	Number of operations	Excess manure phosphorus, pounds	Acres available for manure application per farm with acres***	Number of farms without acres of 24 crops or pasture-land
50–75% of total animal units on farm	55,466,145	39,498,199	3,113	27,162,455	137	101
0 to 30,000 head broiler capacity	1,403,879	975,079	281	599,332	42	30
30,000 to 60,000 head broiler capacity	5,430,765	3,805,394	616	2,467,196	72	20
60,000 to 90,000 head broiler capacity	7,959,644	5,608,362	642	3,705,055	99	19
90,000 to 180,000 head broiler capacity	20,751,648	14,755,709	1,077	9,838,671	148	23
180,000 or more head broiler capacity	19,920,210	14,353,655	497	10,552,201	291	9
Turkeys dominant						
>75% of total animal units on farm	190,565,981	157,066,216	2,925	149,793,940	184	931
0 to 16,500 head turkey capacity	22,117,930	18,073,469	1,096	16,380,899	107	371
16,500 to 38,500 head turkey capacity	53,397,484	43,830,574	1,120	41,000,260	176	313
38,500 to 55,000 head turkey capacity	27,609,728	22,724,161	339	21,716,166	255	103
55,000 or more head turkey capacity	87,440,839	72,438,012	370	70,696,613	388	144
50–75% of total animal units on farm	14,614,808	11,360,276	302	9,238,028	378	27
0 to 16,500 head turkey capacity	3,680,128	2,721,606	164	2,002,449	195	15
16,500 to 38,500 head turkey capacity	5,688,400	4,408,195	105	3,823,292	400	9
38,500 to 55,000 head turkey capacity	2,189,681	1,754,614	19	1,363,709	1,208	2
55,000 or more head turkey capacity	3,056,598	2,475,861	14	2,048,579	1,235	1
Mixed, no dominant livestock type	39,405,411	22,703,813	996	4,854,889	236	77
Total	3,840,216,707	1,436,796,450	89,028	929,109,365	133	31,474

* See footnote to table E–1 for explanation of enterprise types and farm capacity estimates.
** Includes all animals on the farm, both confined and not confined.
*** Acres per farm are based on 24 crops and pastureland on farms with acres. Farms without acres were not included in the calculation.