

# Agricultural Composting in the United States

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■ In the United States, more farms are composting than municipalities, commercial/institutional establishments, and other private sector groups combined. To obtain an overview of agricultural composting in the United States, industry, government, and university representatives from the top 10 beef and dairy cattle, poultry, and swine producing states were contacted between January and April of 1995. These states represent at least 70 percent of the nation's production of these commodities (except for beef cattle at 52 percent). The representatives provided information about the number of farms composting, the materials composted, composting methods, how the compost is used, and motivating and impeding factors for farms to compost. In addition, informa-

tion was gathered concerning composting crop residues. In this case, specific applications of crop residue composting were identified and individuals knowledgeable about the applications were contacted for background information.

Note the estimated numbers of composting operations presented here represent a best attempt to quantify the composting activity taking place on various types of farms. In many cases, the numbers are rough estimates, based on the assessments of the representatives contacted in each state. Also, they only include the composting operations in the top 10 producing states. A considerable amount of composting occurs outside of these states. Therefore, Tables 1 and 2 underestimate the number of farms that compost.

The information presented below is arranged by individual commodity groups. The authors have tried to make a distinction between composting and minimally managed practices such as dry stacking of manure (*e.g.*, many farmers store manure in piles and allow them to self-heat prior to land application or other use). Such practices were not counted as composting since there is no deliberate attempt to produce a stable end product.

## The Beef and Dairy Cattle Industries

Manure from beef cattle occupying range and pasture land is dispersed by the animals. Therefore, in the beef cattle industry, composting is limited to manure generated at feedlots. Where beef cattle manure is composted (see Table 1), it is usually done in windrows with front-end loaders or windrow turning machines, alone or in combination with locally available materials, such as cotton gin by-products, straw, yard trimmings, newspaper, or biosolids. Most feedlots that compost do so themselves, though in

at least one case a nearby farm composts the manure, mixed with yard trimmings, for its own use.

Composting is chosen to reduce the volume and/or water content of the manure before it is land applied, reduce the volume of the manure so it can be hauled further and improve the quality and/or marketability of the manure by adding to its value and aiding in the manual or mechanical removal of rocks, concrete and other undesirable materials. Composting is also chosen because compost is more homogeneous and spreads more evenly than manure, contains much fewer weed seeds, improves the soil by improving its fertility and increasing its organic matter content and reduces water pollution.

Dairy farms primarily compost solid manure collected from barns and open lots and manure solids, separated from liquid manure collection systems. While composting of manure is somewhat novel, composting of separated solids is a long-standing practice among farms with liquid manure handling systems. The composted solids are usually recycled for animal bedding.

**TABLE 1. Estimated number of beef and dairy cattle operations composting manure in the top ten producing states (as of March 1995)**

Beef Cattle		Dairy Cattle	
State <sup>a</sup>	Operations Composting	State <sup>d</sup>	Operations Composting
California	2	California	e
Colorado	20	Idaho	8
Kansas	10-25	Iowa	6
Nebraska	10 <sup>b</sup>	Michigan	19
Texas	10 <sup>c</sup>	New York	12
		Pennsylvania	15
		Texas	5
		Washington	6
		Wisconsin	20 <sup>f</sup>
Total	≥52-67	Total	> 91

<sup>a</sup>Iowa, Missouri, Oklahoma, South Dakota and Wisconsin had none reported.

<sup>b</sup>One of these operations has some of its manure composted on another farm (included as one of the 10), and composts the rest.

<sup>c</sup>Ten beef cattle feedlots have contracted with five firms to compost their manure.

<sup>d</sup>Minnesota had none reported.

<sup>e</sup>According to a state survey, 11.3 percent of California dairy farms compost manure (Meadows and Butler, undated); however, this includes dry stacking manure.

<sup>f</sup>This is a rough approximation, according to several Wisconsin contacts.

Nearly all dairy farms that compost employ the windrow method. Separated solids are composted with minimal effort in bins or free-standing piles, receiving one to three turnings simply by moving piles with a bucket loader. Manure is usually composted alone, but also in combination with dry carbon-rich materials, including straw, corn cobs, sawdust, dry leaves, paper and cardboard.

Dairy farms that practice composting are diverse in type and nature, though there may be localized patterns. For example, in Wisconsin, composting is most prevalent among dairy farms that practice rotational grazing. In Iowa, composting takes place mostly at small dairies which use bedding and produce solid manure. However, in southern California and Idaho, composting occurs primarily on large open-lot farms which need an outlet for excess manure.

Composting is a manure management practice for only a small percentage of dairy farms. Nevertheless, it has expanded substantially over the last five years. Most of the representatives surveyed expect dairy manure composting to continue to increase due to more stringent rules for land application of manure, plus increasing opportunities to compost off-farm materials. However, some trends in

the dairy industry are unfavorable to composting. Many farms are reducing or eliminating the use of traditional organic bedding materials, replaced by sand or stall mattresses in some cases. More farms are also adopting liquid manure handling systems. Both of these practices produce wetter manure. Composting becomes less feasible, technically and economically, because more dry amendments are required.

### The Poultry Industry

Composting in the poultry industry (including broilers, layers and turkeys), and agriculture in general, is led by the composting of mortalities (see Table 2). Approximately 5,000 farms in the top 25 poultry producing states composted their mortalities as of mid-1994 (Kashmanian 1995). For the states listed in Table 2, the number of poultry farms composting mortalities increased from 3,603 in mid-1994 to 4,656 by mid-1995.

Research and publications from the University of Maryland and demonstrations at the University of Delaware led to the adoption of a national standard for dead poultry composting by the U.S. Department of Agriculture's (USDA's) Natural Resource Conservation Service (NRCS), formerly the Soil Conservation

**TABLE 2. Estimated number of poultry operations composting manure and mortalities in the top ten poultry producing states (as of March 1995)**

State	Operations Composting Manure	Operations Composting Mortalities	Total Operations Composting
Alabama	nr	1,000-1,200	≥ 1,000-1,200
Arkansas	12 <sup>a</sup>	1,150	1,162
California	10 <sup>b</sup>	3-6	13-16
Delaware	nr	c	nr + c
Delmarva <sup>d</sup>	nr	1,042	≥ 1,042
Georgia	3	100	103
Maryland	1-10	c	1-10 + c
Mississippi	nr	306	≥ 306
North Carolina	6-12	590 <sup>e</sup>	596-602
Texas	nr	165	≥ 165
Virginia (outside Delmarva region)	nr	300	≥ 300
Total	32-47	4,656-4,859	≥ 4,688-4,906

<sup>a</sup>About 12 farms sell manure each year to a commercial composting company

<sup>b</sup>Includes two commercial operations

<sup>c</sup>Included under Delmarva

<sup>d</sup>The Delmarva region includes Delaware, nine Eastern Shore counties of Maryland and two Eastern Shore counties of Virginia.

<sup>e</sup>Based on the number of permits issued

nr = None reported

Service. This work also benefitted composting projects in many other states and has led to the consideration to compost swine and other livestock mortalities.

Poultry mortalities are composted in either two-stage composting bins or minicomposting bins for smaller birds and operations. Two-stage composters include a primary stage to initiate the composting process and a secondary stage to complete the process and temporarily store the compost. Minicomposters have a single-stage composting process and do not require turning (Donald *et al.* 1994; Murphy 1992-1993). For the states contacted, up to 55 percent of the poultry farms that composted their mortalities used minicomposters. Materials added to the composting units include poultry litter (a mixture of poultry manure and bedding) and locally available materials, such as straw, peanut hulls, wood shavings and cottonseed hulls.

Where poultry *manure* is composted, it is done in open or enclosed windrows, or in-vessel. The nitrogen in the manure is sometimes balanced by adding carbonaceous materials, such as leaves or sawdust, even if bedding material is already mixed in.

According to the information collected, relatively few poultry farms compost manure. Compared to other livestock enterprises, poultry farms tend to grow less feed and therefore are less likely to have a land base for agronomic application of manure. Because of this, composting manure may have greater potential among poultry farms, though research for this paper did not seek to confirm this.

### The Swine Industry

Because swine manure, especially from larger operations, is typically collected with water and handled as a liquid, it is considered too wet to be composted (*e.g.*, 97 percent liquid). Separation of manure solids is not common among swine farms so the cost and uncertain effectiveness of manure solids separation are barriers to composting swine manure. Nevertheless, a research project at North Carolina State University will study composting of swine manure mixed with peanut hulls, an inexpensive and locally abundant by-product. The manure will be scraped from floors and collected from manure pits after settling and evaporation remove some of the moisture.

Following research and efforts in the poultry industry to compost their mortal-

ities, there is growing interest in the swine industry to compost mortalities. Missouri has at least 100 swine operations composting mortalities and 10-12 swine operations compost their mortalities in Indiana. The other top 10 swine producing states, Illinois, Iowa, Kansas, Minnesota, Nebraska, North Carolina, Ohio and South Dakota, had none reported.

The primary barrier identified to compost swine mortalities is that some states do not allow it, or they allow it only if special permits are obtained by the farm. Since this type of composting is relatively new, several questions remain to be answered before many states approve the practice.

A number of these questions are being addressed in various research projects. For example, in research at Ridgetown College in Ontario, Canada, composting of whole swine carcasses, including sows over 450 pounds killed *Salmonella typhimurium*, *Streptococcus suis*, *Bordetella bronchiseptica*, *Listeria monocytogenes*, *Actinobacillus suis* and *Actinobacillus pleuropneumoniae*. High temperatures, averaging over 50°C through the winter (when the composting piles were started before the winter), were sufficient to kill these pathogens. Higher temperatures were achieved when sawdust was added as a bulking agent, rather than straw. The researchers recommend the top layer should have 24 inches of sawdust for insulation or a thickness of 48 inches if straw is used (Morris *et al.* 1994/1995). In research at North Carolina State University, composting swine mortalities (with wheat straw or peanut hulls as the bulking agent) killed off the Aujeszky's disease virus (also known as pseudorabies) and *erysipelothrrix rhusiopathiae*, and most of *Salmonella*. Carcasses less than 30 pounds were composted whole, while the sows (over 300 pounds) were dismembered, with their abdomens opened and diaphragms punctured to expose more surface area to microbial activity (Morrow *et al.* 1995).

State guidelines from the University of Missouri for composting swine mortali-

ties, in combination with proper composting setup and process controls, are considered sufficient to deter dogs and rodents. One composting method developed by the University uses a low cost, three-sided enclosure made with large round hay bales, five to six feet in diameter. The swine carcasses are separated by layers of sawdust 12 inches thick. Using these procedures, little, if any, leachate has been detected in this research. However, if straw is used, a roof may be required to deflect rain water and prevent leaching from the pile. Many farms are using a concrete pad because of its appearance and workability in all weather conditions. The most successful composting has been achieved using sawdust as the bulking agent, "due to its small particle size, ease of handling, absorbency and high carbon content" (Fulhage and Ellis 1994). The hay bales have also been tested by the University Illinois, and typically no leaching has occurred.

### Composting Crop Residues

For many years, crop residues, such as straw and corn cobs, have been composted as amendments for other materials, particularly manure and biosolids. More recently, several crop residues have become the object of composting. Although it is not a widespread practice, composting is being employed in certain locations to process and recycle cull potatoes, grass seed straw, seed screenings, cotton gin by-products, pomace from wineries and residues from the collection and processing of sugar beets, blueberries, cranberries and apples. The specific reasons for composting differ with the commodity and local situation, but generally, crop residues are being composted because traditional management methods are no longer acceptable. The following examples typify most applications.

Cull potatoes have been composted on at least six farms in Maine to control the spread of late blight disease from culls spread on the land. The potatoes are composted in windrows with sawdust and/or wood by-products. The composting

process destroys the virus causing the disease. The compost has been successfully used as a soil amendment in potato fields.

One farm in Idaho is composting alfalfa seed screenings and applying the compost to its crop land. Screenings are the undersized residue separated from marketable alfalfa seeds (weed seeds, pieces of the plant, undersized alfalfa seeds, etc.). The screenings cannot be applied to crop land directly because of the weed seeds and because some pesticides used on the alfalfa seed crop are not approved for food-chain crops. Research conducted by the Idaho Department of Agriculture and Oregon State University has demonstrated that nearly all weed seeds and pesticide residues decompose via composting, although a few species of weed seeds persist. Incineration and landfilling are other methods for handling the screenings.

At least four wineries in California are composting pomace, the residue from pressing grapes. In this case, the reason for composting is to produce compost for use in the vineyard. Although pomace can be directly applied to vineyard soil, compost is preferred as a soil amendment.

## Conclusion

According to information collected from state representatives and previous investigations, there are well over 7,000 farms currently composting in the U.S. However, this number does not include farms that are composting in states that were not contacted. By far, the majority of farm composting takes place on poultry farms for the handling of mortalities, and has been driven by the need to find an alternative handling method. These farms represented approximately 12 percent of all poultry farms in the 25 largest poultry producing states in 1994 (Kashmanian 1995). In contrast, a very small percentage of farms compost manure or crop residues. Although it is still relatively uncommon, many unique and successful applications of composting exist.

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