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DAIRY WASTE COMPOSTING

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Composting is one of several alternatives for managing dairy manure solids and bedding and can be environmentally friendly. In this fact sheet the benefits and costs of two common composting methods are discussed.

Benefits of Composting

Composting converts manure and bedding nutrients to a more stable form, adds humic acid to the soil, increases beneficial soil organisms, improves soil tilth and aeration, reduces raw manure odors, and reduces reliance on synthetic fertilizers. Although compost is not usually marketed as fertilizer, it can add nutrients to the soil. Compost users include home gardeners and landscapers as well as farmers and local governments (Fabian et al., 2000).

Most compost from agricultural waste is currently being used directly by the farm or local government (e.g., for easement plantings) or is sold in bulk in many locations for prices near $10 per cubic yard (Fabian et al., 2000). In Washington, final compost is often marketed at $12 or more per cubic yard F.O.B. The price of compost depends on the amount purchased, quality, promotion, packaging, and associated services.

In addition to the potential revenue from compost, it is frequently preferred for environmental reasons. Manure used in compost quickly breaks down, provides slow release of nutrients, has less odor, may require less acreage for application (depending on soil nutrient load), and has excellent benefits for soil. In addition, waste disposal fees in the neighborhood of $50 to $100 per ton have become common (Fabian et al., 2000), so revenue can sometimes be generated by charging disposal fees.

How Is Compost Produced?

Various methods are available to produce compost. They include passive windrow, turned windrow, in-vessel/channel, extended aerated static pile, and vermi-composting. These methods vary greatly in the quality and consistency of compost produced, investment required, and operating costs.

The passive windrow method uses a tractor with a front-end loader to turn windrows. It is relatively simple and cheap, but produces the lowest and least consistent quality of compost. When implemented on the dairy, this approach may not require any additional equipment or investment unless drying pads, runoff prevention measures, or covered spaces are needed. The volume of materials this method can handle range from a few hundred to several thousand cubic yards per year. This method of composting minimizes new investment and requires a relatively low level of management intensity (Rynk, 1992).

The turned windrow method requires more capital and labor than the passive windrow method, but the expenditures may still be reasonable because most dairy farmers already own some of the necessary equipment. Farmers can manage windrows at a moderate level of intensity by purchasing a specialized windrow turner. This method requires a moderate amount of labor. For larger operations, a fully integrated, self-contained windrow turner costing about $200,000 greatly reduces labor costs. Final product quality is high and the composting period is short.

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For these reasons, the turned windrow method is currently the most popular method for on-farm composting (MacConnell and Chaudiere, 2000).

The in-vessel/channel composting method requires little labor, product quality is high, and space requirements are small. The extended aerated static pile method requires a system of perforated PVC pipe covered with a layer of shavings and topped with about 8 feet of fresh manure solids and then covered with pre-composted solids. Air is forced through the pipes at variable rates essential to maintain consistent composting temperatures. However, these methods are not popular for most on-farm operations since they require investment in expensive equipment and skilled labor.

Vermi-composting produces the highest quality compost, and in some cases can be the least expensive method. It requires little equipment and labor. The major requirements are a large amount of covered space, the means to move the materials (a turner or front-end loader), and screening equipment. This method tends to be used only on a small scale.

Because of their broader potential for handling dairy waste, we focus on the passive and turned windrow methods in this fact sheet.

How Much Does Composting Cost?

Depending on the scale of operation and the technology adopted, initial outlays for planning, permits, site preparation, and investment in equipment and the site can vary greatly. Initial outlay can range from a few hundred to hundreds of thousands of dollars (Fabian et al., 2000). To determine net benefits or costs of composting, several factors must be considered—quantity of solid manure and bedding, land available for the compost facility, market for compost, and transportation costs.

Costs depend on the quantity of manure composted. Many farmers compost several thousand cubic yards of material without significant additional costs (Fabian et al., 2000). However, when large volumes of manure and bedding are composted, land, labor and capital investment can be substantial.

Land available for composting will influence a farmer's decision about composting. At least one acre of unused or underutilized land with suitable slope, drainage, and access is required for the composting facility (Fabian et al., 2000). Concrete slab and cover may be important for efficient composting. Compost leachate must also be contained or filtered to avoid water contamination. Depending on the technology used, one acre can accommodate 2,000–10,000 cubic yards of materials per year. Larger investments in equipment or technology substitute for scarce land.

The market outlet for the finished compost is critical. Compost of consistent high quality can be sold easily and profitably. More capital investment in equipment, such as screens, is needed to improve the quality and consistency of the final product. Marketing costs are also frequently required if farmers sell compost rather than apply it on their own farms. However, if they plan to add all or most of the compost to their own soils, they can simplify their compost systems and avoid much of the expensive equipment since they add little value to compost used for farm application (Fabian et al., 2000).

Transportation costs can be substantial and warrant specific consideration. They include the cost of transporting manure to the compost site and then transporting final products to market or to the land where the compost will be applied. Transportation costs may increase substantially if manure and bedding from several dairies are transported to a central composting facility to take advantage of economies of size. Carefully balancing transportation costs and economies of size can help minimize costs per ton of compost and make possible the efficient utilization of expensive fixed investments such as specialized composting equipment and land.

Costs of a specific compost system also depend on additional variables, which vary from farm to farm. Such variables include labor cost, fuel price, land value, equipment investment and maintenance cost. Because various combinations of land, labor and equipment can produce desirable compost using different technologies and management systems, the farmer has several options for using existing resources in a cost-effective way (Fabian et al., 2000).

Investment requirements, annual fixed and operating costs, and returns from dairy manure and bedding composting operations are developed for five western Washington herds in the Extension bulletin, *The Economics of Dairy Nutrient Management.* Both passive windrow and turned windrow methods are

examined. Both the extension bulletin and linked spreadsheets are available online. The spreadsheets permit the producer to tailor the calculations to a specific operation. They can be downloaded or ordered on compact disk from <farm.mngt.wsu.edu/dairy.html>.

Much of the equipment required to engage in composting is already available on many dairies. With the passive system, primary equipment used to convert solid dairy manure and bedding to marketable compost include a tractor, front-end loader, and screen. The screen is used to separate materials of different sizes and shapes and improves the quality of the compost for sale or use. In farm composting systems, the screening is nearly always performed following composting (Rynk, 1992). It is unnecessary if farmers choose to apply compost to their land rather than selling it. Sufficient storage space for the dairy waste and compost is also needed. A windrow turner replaces the front-end loader in the turned windrow method.

For dairies that need to purchase all the necessary equipment and add storage space, costs for a 250-cow herd could exceed $100,000 for a passive windrow system and $200,000 for a turned windrow system. For larger herds, equipment costs for a turned windrow system are similar to those for a passive windrow system. For a 3,000-cow herd, both require investments in excess of $350,000. With an 8 percent annual interest rate, the total annual fixed cost for a passive windrow composting system ranges from $13,000 for a 250-cow herd to $65,000 for a 3,000-cow facility. For the turned windrow system, these figures range from $29,000 for a 250-cow herd to $46,000 for a 3,000-cow herd.

Because the turned windrow composting system requires fewer operator hours, total operating costs are lower for the turned windrow system than for the passive windrow system. While it requires a larger investment for smaller herds, the savings in operating costs makes the turned windrow system more attractive for dairies with 1,000 or more cows as well as for a centralized facility.

When Is It Beneficial to Compost Dairy Manure and Bedding?

Using the assumptions made in this fact sheet, we find that composting dairy manure and bedding is economical primarily for dairies with more than 1,000 cows. For smaller herds, it may be preferable to combine efforts and create a centralized composting facility with nearby dairies. However, if a net expense is incurred in disposing of non-composted solid manure and bedding, if processing or tipping fees can be obtained to compost off-farm waste materials, or if the compost operation can be implemented with minimal investment in additional equipment and storage area, composting can also be feasible for smaller dairies.

How Is Compost Marketed?

The main challenge farmers must address before starting on-farm composting or cooperating in the organization of a central composting center is to determine whether the final product can be marketed successfully and economically. It is better to examine the potential market for the product before beginning production. For most dairies, composting would represent a new enterprise. Evaluating the potential market often determines the success or failure of a venture. Thus, the farmer should consider how much of the product can be sold and at what quality and price.

To sell large quantities of compost may require marketing. This means searching out potential buyers, advertising, packaging, managing inventory, matching the product to the customers' desires, and maintaining consistent product quality (Rynk, 1992).

After identifying potential buyers, the size of the compost market must be determined. Because transportation costs are very high in comparison with other compost production costs, the market for compost is generally local, within 25–50 miles of the composting facility. Providing a variety of compost products may increase success in developing a market. In addition to compost, a composted mulch material could be offered, which is made from a blend of compost and soil. Different grades of compost such as soil amendment grade, a nutrient-rich fertilizer grade, or a potting medium grade may also be marketed (Rynk, 1992).

Finally, the supply of compost available to customers must be reliable. Most compost is used in the spring and early summer, so the product should be stable and suitably dry for delivery at that time.

When Is a Centralized Compost Facility Beneficial?

A larger composting facility can economically use the turned windrow system. It can also reduce the

break-even price for compost substantially because of economies of size. Thus, it may be economical for several small dairies to cooperate in creating a composting center. Alternatively, a separate business could be established to receive solid manure and produce compost. Which option is preferred depends on the costs of transporting manure to the composting center relative to the savings in composting costs.

Although there are many benefits to on-farm composting for on-farm use, composting requires equipment, labor and management. Composting may also require additional land and building space to store raw materials and the final compost product. Weather is an important factor to consider before starting an on-farm composting program. Cold weather and heavy precipitation will greatly affect the composting process. Thus, it is not suitable for all farmers to practice on-farm composting. The same problems must be faced by a central composting center, but may be more economically dealt with by a larger facility that has its own management, capital, and labor force.

Assuming a transportation cost of $1.20 per ton mile (Jessup, 2002) and a market price of $14 per cubic yard of compost, the break-even mileage to get dairy manure and bedding from a total of 8,000 cows to a centralized composting facility varies from 25 miles for 250-cow dairies to 2 miles for 3,000-cow dairies. Under the stated assumptions, farmers could consider transporting their manure up to these distances to get to a central composting facility. Consequently, dairies need to be reasonably concentrated to justify a large centralized facility that only composts dairy manure and bedding.

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Where Can I Get Help in Decision Making?

Making decisions regarding the disposal or marketing of dairy waste can be very difficult. Is it more cost effective to transport compost to a centralized facility? Is the revenue generated from marketing compost worth the additional expense? These are questions that you may be pondering. For more information you can access the Extension bulletin entitled *The Economics of Dairy Nutrient Management* online. Along with the bulletin, there is an appendix and a set of linked spreadsheets that will help you in many of the decisions you face. They can be downloaded or ordered on compact disk from <farm.mngt.wsu.edu/dairy.html>. And, of course, you can always contact your local offices of WSU Cooperative Extension or the USDA Natural Resources Conservation Service for additional information.

References Cited

Fabian, Eileen E., Tom L. Richard, David Kay, David Allee, and Joe Regenstein. "Agricultural Composing: A Feasibility Study for New York Farms." Staff Report, Departments of Agricultural and Biological Engineering, Agricultural Economics, and Food Science, Cornell University. Downloaded from <http://www.cals.cornell.edu/dept/compost/feas.study. html>, 11 September 2000.

Jessup, Eric. Personal communication. Assistant Research Professor, Department of Agricultural and Resource Economics, Washington State University, May 2002.

Liu, Qinghua, C. Richard Shumway, and Kelli J. Myers Collins. *The Economics of Dairy Nutrient Management.* Cooperative Extension Bulletin EB1947E, Washington State University, 2002.

MacConnell, Craig, and Wayne Chaudiere. "Whatcom County Manure Compost Marketing Guide." Whatcom Conservation District, Cooperative Extension, Washington State University, Washington State Department of Ecology Centennial Clean Water Fund, 2000.

Rynk, Robert. "On-Farm Composting Handbook." Northeast Regional Agricultural Engineering Service. Ithaca, NY, 1992.

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