COMPOST SUPPLY AND DEMAND

A recent study estimates the total production of compost from four major sources in the United States to be approximately 50 million tons annually, with potential demand in nine markets to be 500 million tons per year.

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AS COMPOSTING programs grow and expand throughout the United States, the potential market size for the compost generated is a critical issue. A study conducted by Battelle[1] provides a quantitative analysis of the potential supply and demand for compost. Our study estimates the total production of compost from four major sources to be approximately 100 million cubic yards (50 million tons) per year and the demand for compost by nine important markets to be approximately one billion cubic yards (500 million tons) per year, 10 times greater than the potential supply.

The Battelle study segments organic wastes into four major groups to estimate the potential supply for compost: the organic fraction of MSW; sewage sludge; horticultural/silvicultural wastes; and agricultural wastes. The future supply of compost from these four waste types was estimated on the basis of current quantities produced and possible changes in composting practices. Estimates of the potential compost supply and current compost supply are shown in Table 1.

POTENTIAL SUPPLIES

MSW Compost: In the long term, MSW will be the major source of finished compost accounting for 30 million tons of the total 51 million. For the purpose of estimating future supply, the U.S. production of MSW is assumed to surpass 200 million tons per year.[2] About 80 million tons of MSW either will not biologically decompose or can be recycled (i.e., glass and plastic), leaving approximately 120 million tons of MSW that possibly could be composted. Approximately 40 million tons will be incinerated, leaving 80 million tons of compostables which will yield roughly 40 million tons of unrefined compost. (Two tons of organic MSW will yield roughly one ton of compost.) During refinement, it is estimated that 10 million tons will be screened off and landfilled, leaving 30 million tons of finished compost.

The continuation and growth of other MSW management practices, such as increased capacity for paper repulping and waste-to-energy plants (incineration), will result in competing demands for some compostables. Thus, the growth of MSW compost is expected to be constrained, and our estimate is conservatively high.

Sewage Sludge Compost: The U.S. EPA estimates that sewage treatment plants in the United States produce about 7.7 million dry tons of sewage sludge annually[3]. One dry ton of sludge plus bulking agent produces about 2.5 tons of moist compost. Assuming 15 percent of the sludge will be composted, the estimated potential supply of sludge compost is three million tons. Current estimates for sludge disposition are land applied: 50 percent; incinerated: 20 percent; landfilled: 15 percent; Composted and other: 15 percent.

Horticultural/Silvicultural Wastes Compost: A number of commercial compost producers already make approximately five million tons of very high quality compost from bark, used mushroom media, sawdust and other horticultural and landscape residuals[4]. To estimate the potential supply, Battelle staff judged that this amount could at most triple in the future to 15 million tons annually. Additional sources of organic wastes, such as paper sludge, or other wood processing residue, would be used to reach this potential.

Agricultural Residuals Compost: The U.S. Department of Agriculture estimates about 180 million dry tons of manure are produced annually by livestock and poultry[5]. The vast majority of this material is directly land applied by the animals or farmers. Manure and manure composts have relatively high plant nutrient values and are often registered and sold as organic fertilizers. Approximately 300,000 tons of organic fertilizers are sold annually. For the purpose of estimating potential supply, animal waste compost was judged to be 10 times greater than the above fertilizers already produced[6]. This results in an estimated supply of compost from animal wastes of about three million tons annually. Most of this would come

from manure generated at large livestock operations, such as dairy farms, cattle feedlots, hog farms, and poultry or egg producers.

POTENTIAL DEMAND

Our study segmented the application of compost into nine markets which comprise about 95 percent of the demand for compost. This segmentation was chosen to take advantage of available national statistics and avoid the potential of double counting due to overlap. The potential compost demand by these nine segments and the current penetration of compost (based on Battelle estimates) into these markets are shown in Table 2. It is assumed that the compost would be of sufficient quality to meet user needs. The potential demand estimates do not consider possible future segment growth and, therefore, the estimates should be considered conservative. A state-by-state tabulation of these segment estimates is available[1].

Agriculture: Agricultural uses for compost include soil conditioning, fertilizer, and erosion control. It can be used on vegetable and field crops, forage grasses, for developing marginal lands, and as a mulch after conservation seeding. The estimated demand for compost for agricultural purposes within a 50-mile radius of the 190 largest cities in the United States is 895 million cubic yards per year.

For forage grass applications, a program should be followed to meet the needs of the livestock as well as to ensure the vigor of the pasture. Applications on marginal lands should be based on soil characteristics and the cover crop to be grown. A single heavy application could supply the fertilizer requirements for several seasons.

Cooperative testing, coupled with rigorous quality assurance to satisfy feed/food safety concerns, will encourage increased use of compost in the agricultural market. Field research has shown that with proper pH management and the use of sewage sludges containing low levels of trace minerals, metal uptake by crops is minimized. In addition, improved transportation logistics and costs and development of bulk application equipment will enhance acceptance in the agricultural market.

Improved plant quality, increased crop yield, lower input costs, or combinations of these factors as a result of compost use could result in increased profits for growers. The actual profitability will vary with compost quality, compost price compared to substitutes, and the value of the crop, among other variables. Compost application in combination with inorganic fertilizers is recommended for best results for harvested cropland.

Silviculture: The growing of trees for harvest is the second largest potential application segment for compost. This would include Christmas trees, pulpwood and timber production. With the estimated compost demand for silviculture at 104 million cubic yards per year, this market alone could use all of compost that could possibly be produced.

Over the past two decades, various studies have been conducted on the use of composted waste material on forest lands[7,8]. The results suggest that landspreading and recycling degradable organic wastes in forests can increase tree growth without long-term deleterious ecosystem effects.

Clear lands are necessary for good establishment of many evergreen species, such as pine and fir, and allow easy application and chiseling of the compost into the soil. However in many cases and in woodlot improvement, spreading compost as a mulch will be all that is practical.

As in the agriculture sector, better accessibility to compost supplies via improved transportation logistics and costs, coupled with increased awareness and appreciation of benefits, is expected to improve penetration into this market segment.

Sod Production: Currently, little compost is used for sod production. Sod farms tend to be located where the topsoil or muck is deep. Ten inches of topsoil can last for more than 20 years depending on amounts removed with each harvest. Traditionally, sod farmers move on to new locations when the topsoil is depleted. The estimated compost demand for sod production is 20 million cubic yards per year.

Sod farming is a modest value application with the market potential to develop as the sod producers deplete their topsoil and become more familiar with the benefits of using compost. Applying uncomposted sewage

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Table 1. Potential and Current Compost Supply

Compost Source	*Potential Compost (Tons)*	*Current Compost (Tons)*
MSW	30,000,000	1,000,000
Sewage Sludge	3,000,000	2,000,000
Horticultural Waste	15,000,000	5,000,000
Agricultural Waste	3,000,000	< 300,000
Total	**51,000,000**	**8,300,000**

Source: Battelle

Table 2. Potential and Current Compost Demand

Segment	*Potential Compost Demand (Million Cu Yd)*	*Current Penetration (Percent)*
Agriculture	895.0	<1
Silviculture	104.0	<1
Sod Production	20.0	<1
Bagged/Retail	8.0	80
Container and Field Nurseries	4.9	50
Delivered Topsoil	3.7	<5
Landscaping	2.0	<20
Landfill Final Cover	0.6	<5
Surface Mine Reclamation	0.2	<5
Total	**1038.4**	**<2**

Source: Battelle estimates.

Table 3. Basic Assumptions for Potential Compost Demand

Market	Basic Assumptions	Replacement Application Rate
Landscaping	Replace peat	75%
	Replace bark	33%
Topsoil	Replace organic amendments	100%
Bagged/Retail	Replace peat	75%
	Replace bark	33%
Landfill Final Cover	Top cover 15 inches	2 cu. yd/100 sq. in.
Surface Mine Reclamation		
Active Mine	10% of acres treated	50 cu. yd/acre
Abandoned Mine	10% of acres treated	200 cu. yd/acre
Nurseries		
Container	Replace bark	50%
	Replace peat	25%
Field	All acres treated every five years	50 cu. yd/acre
Sod	All acres treated every year	100 cu. yd/acre
Silviculture		
Christmas Trees	20% replanted acres treated	200 cu. yd/acre
Reforested*		200 cu. yd/acre
Timber Stand Improvement*	50% maximum area treated	200 cu. yd/acre
Agriculture**	20% of acres treated every five years	
Harvested cropland		52 cu. yd/acre
Pasture/Grazing		44 cu. yd/acre
Cover Crops not Harvested		102 cu. yd/acre

** Based on number of tree planted acreage and state population density.*
***Based on assumption that agricultural markets are within a 50 mile radius from source compost production (cities with +100,000 population).*

sludge slurry to sod fields in preparation for seeding is a common practice. Such applications reduce the amount of fertilizer otherwise required to establish sod. Application of compost solids is complicated by the general lack of appropriate compost hauling and spreading equipment. Work is underway to test compost use on sod, and to evaluate application methods.

Residential Retail: The potential for compost to be used by residential customers as a soil amendment/mulch is significant. These customers purchase mulch, such as bark and wood chips, to provide a protective and decorative cover around plants. They also purchase potting soil, topsoil, and amendments containing peat to enrich planting areas. Much of the topsoil sold in bags is made with compost. Most of these products are purchased in bags from garden centers/retail nurseries, hardware stores, mass merchandisers/discounters, feed/seed stores, supermarket/drug stores and home centers. The estimated compost demand for residential retail is eight million cubic yards per year.

Finely screened municipal compost could be very competitive with peat, which is valued by gardeners for its capacity to absorb and retain water, and facilitate plant root development. Bark mulch and wood chips are used frequently by landscapers and homeowners to conserve moisture in the soil, and for weed control and decorative purposes. Coarse blended sludge compost and chipped yard debris are the most likely substitutes for mulch when used for conserving moisture and weed control. There is less potential for municipal compost products when a decorative appearance is desired because these products may be less aesthetically pleasing than bark products. Most mulches are low value products and the cost of shipping long distances is a market constraint. For those states where mulch and wood chips must be transported more than 500 miles, the potential market for locally produced mulch from compost facilities could be significant.

Cost-efficient small quantities of compost in well-labeled containers or bags should increase the compost penetration of the homeowner market, where gardening as a hobby is on the rise. To give homeowners reassurance regarding the safe use of municipal compost products, a high quality product with full quality assurance must be produced consistently. A wide scale education and promotion program also is needed.

Nurseries: Already significant amounts of thoroughly cured compost are used in potting mixes by container growers. The potential for using municipal compost among field stock growers is significant and is currently the subject of intensive research in the Northeast and in Florida. Field grown trees, shrubs and plants are dug, balled, and burlapped in preparation for shipment. It is estimated that 20 tons of topsoil per acre are lost when an average crop is dug. The traditional method for replacing the organic matter is to grow a cover crop every two, three or four years and plow it into the soil. It is feasible periodically to replace the lost organic matter with compost, either screened or unscreened, thus reducing the number of times land must be taken out of production for soil rejuvenation. The estimated compost demand for container and field nursery crops is 4.9 million cubic yards per year.

Some of the important benefits of using municipal compost by nursery growers are: reduced need for fertilizers due to the presence of micronutrients; tendency to suppress plant disease; improved water retention characteristics; and lower cost than peat. In addition, if the product is of high and stable quality, the nursery growers could be a high value market for compost processors.

The compost product will need to be consistent in terms of thorough curing, pH balance, nutrient content, particle size, shrinkage, and water-holding ability. Because nursery crops are grown in a confined space, pests and pathogens must be controlled. Media texture and nutrient levels also must remain within a narrow controlled range. Nursery producers usually place primary emphasis on quality rather than price. High quality, well-tested compost may substitute for bark dust in some applications and, to a lesser degree, for peat moss, depending on its water-holding characteristics.

Complete and continuous testing, in cooperation with nursery owners, to ensure product quality will increase the market acceptance and penetration of municipal compost into the nursery industry. On a region-

al basis, compost suppliers will need to be sensitive and responsive to specific growing constraints.

Delivered Topsoil: The amount of quality, natural topsoil available for establishing new lawns and planting trees and shrubs is rapidly declining, especially near large metropolitan areas where demand is greatest. As the natural supply declines, and the demand for high quality topsoil from new commercial and industrial construction increases, the long term potential for blending compost into topsoil will increase significantly. The estimated compost demand for topsoil is 3.7 million cubic yards per year.

The topsoil market is important for compost usage because topsoil mixers are more concerned about the properties compost will add to their mix and are less likely to place a high importance on the physical appearance of the compost product. This is especially important for compost from MSW because of the potential for wide variation in particle size, shape, and bulk density. A widespread collaborative field testing program may help suppliers understand these needs. A consistent supply of compost must be available so that topsoil suppliers' seasonal needs can be met without costly delays.

Landscapers: The landscape service industry uses large amounts of soil amendments, and is probably the largest purchaser of municipal compost in areas where it is available. Landscape contractors use compost as a top dressing, mulch, and soil amendment for new plants. They often purchase truckload quantities when establishing new landscape areas, but they also are large users of bagged products. The estimated demand for compost for landscapers is two million cubic yards per year.

Landscape architects specify the amount of topsoil and amendments to be used in developing a new landscape, and cost minimization is a key factor. For this reason, a lower priced soil amendment such as compost would be a desirable substitute for more expensive conditioners such as peat. The compost must meet the specifications acceptable to the landscapers.

Once again, collaborative testing will increase the opportunities for compost in this market sector. Landscapers will need assurance that compost does not contain harmful amounts of contaminants. Therefore, more laboratory and applied testing is needed to demonstrate product safety. A consistent supply of compost has to be available to meet seasonal demands.

Landfill Cover/Surface Mine Reclamation: These applications provide an immediate use for municipal compost while other markets are being developed. Landfills in many states are required to have a cap system with a layer of topsoil as part of the final closure operation. There also is a limited need for organic soil amendments in states where abandoned mine lands are being reclaimed. These uses offer a potential stable market for lower grade and nonuniform compost products. The estimated compost demand for these markets is .8 million cubic yards per year.

Benefits of using compost for these purposes include reducing the amount of topsoil needed to develop a good growth of vegetation, and lower fertilizer costs. In addition, particle size, texture, and odor requirements are sometimes less important depending on each state's or even each county's land use restrictions. Both of these markets are usually considered a low revenue market and it is not uncommon for municipal compost to be given away for these beneficial uses.

The soil amendment for these uses is often specified by the state, which provides an opportunity for the development of a somewhat stable market for municipal compost. State governments can assist in promoting the application of compost by formulating an official policy requiring the use of municipal composts as soil amendments, such has been done in New York and a few other states.

ESTIMATING METHODOLOGY

A variety of estimating procedures were used to forecast the potential demand for compost for the nine major market segments. Readers are referred to our full report for details[1]. Some methods were straightforward, such as estimating a replacement rate for currently used soil amendments. This method was used for determining the demand for landscaping, delivered topsoil, residential bagged/retail, and the nursery container markets. Landfill final cover and surface mine reclamation required approximating the average size in acres, the number of mine closings each year, and a typical application rate. Sod demand estimates were based upon depletion of present sod fields and the assumption that compost would be used to develop new fields.

Estimating the potential demand for silviculture and agricultural markets presented a more difficult challenge. A complex, bottom-up procedure was developed that estimated the agricultural acreage within a 50-mile radius from cities with over 100,000 population. Except for Christmas tree production, which was based on the number of acres replanted each year, the bottom-up approach was used. The basic assumptions for determining the potential demand for each major market and its submarkets are shown in Table 3.

CONCLUSIONS

Compost is a proven, valuable soil amendment and the potential demand is significant, far exceeding the potential supply. The development of the compost market is a challenge for all concerned with the reuse of valuable resources.

Penetration of four applications for compost — field nurseries, sod production, silviculture, and agriculture — will be required to ensure that all the compost produced will be utilized. There is good scientific support

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Four major markets — field nurseries, sod production, silviculture and agriculture — will be required to ensure that all the compost produced will be utilized.

for use of compost in these applications but there is little use in practice. Container nurseries already use compost and require a very uniform high quality compost that they often produce themselves. The costs of transport and the need for development of easier application methods appear to be the most significant hurdles.

The landscaper, delivered topsoil, and residential bagged/retail markets create most of the current demand for compost. Landfill final cover and surface mine reclamation create small demand on a national basis but can be very significant at a local level.

Understanding compost users is a basic success criterion, regardless of the market segment. Compost suppliers must make the effort to know clearly what their customers need and want for compost products. For agricultural applications, rigorous quality assurance and feed/food safety concerns must be addressed. For sod and horticulture, phytotoxicity and salt content are important to young crops. For landscaping, aesthetics is a prime factor in a definition of quality and acceptability. Cooperative research and demonstration programs are underway to provide some of the understanding.

The Battelle study has demonstrated the need for compost as we believe it currently exists, and as it could be in the reasonably foreseeable future. It is approximately 10 times greater than the potential supply. What faces compost suppliers is a market development challenge, clearly *not* a lack of outlets. ■

REFERENCES

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