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Table of Contents

List of Tables

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REPORT SUMMARY

Composting is a demonstrated, cost effective, and environmentally beneficial technique for managing a large portion of the solid waste stream. Yard waste--leaves, grass, brush, branches, and other woody waste--can be separated easily so that it does not actually become waste. Instead, yard wastes can be processed into usable horticultural products such as compost, mulch and wood chips. This report shows that home, municipal and regional composting of yard waste can reduce the net economic and environmental costs of solid waste management in Westchester County. From a municipal perspective, municipal and home yard waste composting can yield net savings of $2-25/ton and $62-$133/ton, respectively. Composting can save solid waste transport costs, avoid tipping fees, reduce soil amendment expenditures, lower yard waste processing costs and, in the case of home composting, reduce collection costs.

An overall yard waste management strategy in the County should begin with promotion of municipal leaf composting and home composting of all kinds of yard waste. Brush and wood chipping, as well as incorporation of grass clippings with leaves for composting, can subsequently be added to the municipal programs. Municipal yard waste composting sites can be established within municipal boundaries or through arrangements with a neighboring local government for access to a yard waste composting site. The County could purchase specialized yard waste processing equipment and schedule its use at local government composting sites.

Background:

High costs for waste disposal, shortages of capacity, and environmental and health concerns regarding incineration and landfilling have made solid waste reduction, reuse and recycling priorities. As such, composting is gaining in preference as a waste reduction strategy with local governments.

Purpose of Study:

This is an evaluation of the economic costs and benefits of yard waste composting as a solid waste management strategy in Westchester County, New York. Yard waste (leaves, grass, and woody materials) constitutes an estimated 15%-20% (by weight) of Westchester's solid waste. It can be separated easily before it enters the waste stream, and processed into usable compost and mulch. Since most of the available experience has been with leaves, the discussion centers on leaves.

The work was completed as part of a research, demonstration and education project. Collaborators were Cornell University,

Cornell Cooperative Extension of Westchester County, and the Westchester County Department of Public Works. This report responds to Westchester County's interest in the economics of yard waste composting as it applies to local governments and the County.

Westchester County has budgeted $2.8 million over the next two years to support composting programs. It intends to procure specialized equipment for use at municipal and inter-municipal compost sites, provide loans and grants to municipalities which begin to compost yard waste, and serve as a centralized marketing agent for end products. Detailed economic information on the costs and benefits of composting of yard waste will assist both the County and local governments in deciding how to use this money to manage yard waste efficiently and effectively.

The specific objectives of the study were to analyze:

* how all local governments currently manage yard waste;
* costs and benefits of yard waste composting in comparison with other disposal procedures;
* a County-sponsored pilot leaf composting research and demonstration program (Croton-on-Hudson);
* market potential and distribution options for yard waste products; and,
* yard waste management policy options and implications.

Sources of Information:

Information used in this report was obtained from surveys of Westchester's 43 local governments and from local landscapers, interviews with municipal and County government officials, a pilot demonstration composting facility associated with this project, and relevant literature. Twelve local governments shared considerable information on their municipal composting activities.

Research Methods:

The avoided financial (or out of pocket) costs and economic (including the full value of all resources used, whether paid for or not) costs of composting were compared with other yard waste management options. Avoided costs (of other disposal options) can be viewed as the direct benefits gained by making incremental changes in how yard waste is managed. Environmental benefits and costs were treated descriptively.

Leaf Volume:

For the 12 municipalities studied in detail, collected Fall leaves averaged approximately 10% by weight of the annual residential solid waste stream (range: 60-360 lbs./person; average: 170 lbs./person; most frequent value: 120 lbs./person).

The amount of potential leaf compost that could be produced by diverting leaves from the residential solid waste collected by

the 36 municipalities in the County's Solid Waste District[1] is 20,000-66,000 cubic yards/year[2]. New potential leaf compost is 65% of this amount, or 13,000-43,000 cubic yards/year, based on subtracting the municipalities that already have extensive leaf composting or leaf piling programs. This range reflects a number of uncertainties. But, from a planning standpoint, this portion of Westchester County's leaves should receive attention now, because the figure exclusively covers residential leaves which the County incinerates.

Other estimates are nevertheless useful over the long-term. The County-wide total potential leaf compost that could be produced annually from residential leaves is 22,000-74,000 cubic yards[3]. If one adds uncertain estimates for private hauler commercial waste (4% leaves), then the potential would rise to 38,000-126,000 cubic yards.

Fall Leaf Collection Costs:

Fall leaf collection costs averaged $13 per cubic yard (range: $4.50-$20.00/c.y.), or $13.50-$27.00 per household (nearly $4-8/resident). The experience in Mt. Pleasant suggests that collecting leaves bagged by residents ($66/ton, excluding bag cost) can be much less expensive than collecting loose leaves ($110/ton). This, however, is possibly a special situation, and should not be interpreted as a general conclusion. One local government official stated that large compostable paper bags are preferable over plastic bags, since emptying leaves from the plastic bags used would have consumed too much labor time.

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[1] Solid Waste District members participate through Inter-Municipal Agreements (IMAs). Seven Westchester municipalities are not part of these agreements.

[2] This calculation uses the following figures and estimates: total 1987 IMA residential waste delivered to Charles Point, 472,000 tons; total 1987 IMA commercial waste delivered to Charles Point, 38,000 tons; total 1987 private hauler commercial waste delivered to Charles Point, 147,000 tons; leaves as percent (weight) of private hauler commercial waste, 0%-4%; leaves as percent (weight) of residential waste, 7%-10%; potential diversion of leaves, 80%; average leaf compaction rate, 5 cubic yards per ton; volume reduction, 65%-85%.

[3] This calculation uses the following figures and estimates: total 1987 County residential waste, 531,000 tons; total 1987 County commercial and private carter waste, 371,000 tons; leaves as percent (weight) of private hauler commercial waste, 0%-4%; leaves as percent (weight) of residential waste, 7%-10%; potential diversion of leaves, 80%; average leaf compaction rate, 5 cubic yards per ton; volume reduction, 65%-85%.

No local government was identified as charging a user fee for collection of yard waste, nor aggressively promoting home composting. Yorktown came closest, by picking up leaves only in large (33 gallon) compostable paper bags that cost residents $0.25 each. Yorktown subsidized the financial costs of the bags, which cost $0.27 each plus the labor cost of selling the bags to residents.

Leaf Processing Methods:

The County still handles approximately two-thirds of the residential leaves generated within the 36 IMA local governments.

Local governments manage leaves by:

* composting, 20 local governments (48%);
* piling (not reusing or managing), 11 local governments (26%);
* incinerating, at least 18 local governments (43%);
* other, 10 local governments (24%).

"Other" includes disposal in a local government's own landfill or dump, and disposal outside the County. Some local governments rely on more than one primary leaf management method. For example, several local governments compost loose leaves, and incinerate or landfill leaves collected in plastic bags. Few local governments collect Spring leaves separately and compost them. Scarsdale composts the most Spring leaves.

Tables 1 and 2 summarize the predominant ways that Westchester local governments manage leaves, and what amounts some divert from the residential waste stream. Local governments that incinerate most or all of their leaves are capitalized in bold, to highlight the sources of leaves that are processed by the County. Yonkers, with 22% of the County's population, can become a pivotal player in reducing the solid waste burden through yard waste composting.

Cost Savings:

Home, municipal and regional composting of yard waste can reduce net economic and environmental costs of solid waste management. These options are cheaper than disposal within the County or disposal outside the County, which can be as high as $120/ton. In deriving the following figures, these assumptions were made: land is available at no additional cost, and yard waste product sales yield no net income. In fact, however, the actual cost and availability of suitable land will be a key factor that determines whether or not a composting program will be feasible. With land prices commonly in the quarter million dollar per acre range, this observation should be obvious.

From a municipal perspective, municipal and home yard waste composting can yield net savings of $2-25/ton and $62-$133/ton, respectively. Composting saves solid waste transport costs

TABLE 1

PRIMARY LEAF MANAGEMENT PRACTICES OF WESTCHESTER COUNTY LOCAL GOVERNMENTS, AS OF DECEMBER 1988

MUNICIPALITY	COMPOSTING	PILING	INCINERATING	OTHER*
CITIES:				
Mt. Vernon	No	Yes	**YES**	
New Rochelle	Yes	Yes	No	
Peekskill	No	No	**YES**	
Rye	No	No	**YES**	
White Plains	Yes	No	No	Yes
Yonkers	No	Yes	**YES**	
TOWNS:				
Bedford	Yes	No	No	
Cortland	No	No	**YES**	
Eastchester	Yes	No	No	
Greenburgh	No	Yes	**YES**	
Lewisboro	Yes	No	No	
Mamaroneck	Yes	No	No	
Mt. Pleasant	Yes	No	No	Yes
New Castle	No	Yes	No	Yes
North Castle	No	No	No	Yes
North Salem	Yes	No	No	Yes
Ossining	No	Yes	**YES**	
Pound Ridge	No	No	No	Yes
Somers	No	No	No	Yes
Yorktown	Yes	No	No	
VILLAGES:				
Ardsley	No	Yes	No	
Briarcliff Manor	Yes	No	No	Yes
Bronxville	Yes	No	No	
Buchanan	Yes	No	No	
Croton-on-Hudson	Yes	No	No	
Dobbs Ferry	No	Yes	**YES**	
Elmsford	No	Yes	**YES**	
Harrison	No	No	**YES**	Yes
Hastings-on-Hudson	No	No	**YES**	
Irvington	Yes	No	No	
Larchmont	???	???	???	
Mamaroneck	Yes	No	No	
Mt. Kisco	No	Yes	No	
North Tarrytown	No	???	???	???
Ossining	No	Yes	**YES**	
Pelham	No	No	**YES**	
Pelham Manor	No	Yes	**YES**	Yes
Pleasantville	Yes	No	No	
Port Chester	Yes	No	**YES**	
Rye Brook	Yes	No	**YES**	
Scarsdale	Yes	No	No	
Tarrytown	Yes	No	No	
Tuckahoe	No	No	**YES**	

* Includes disposal in own local government landfills and dumps or out of the County.

TABLE 2
FALL LEAVES DIVERTED AS PERCENTAGE OF ANNUAL RESIDENTIAL SOLID WASTE, SELECTED WESTCHESTER LOCAL GOVERNMENTS, 1988

Local Government	Fall 1988 Leaves Diverted (tons)		1987 Residential Solid Waste (tons)	Fall 1988 Leaves Diverted, Percentage of Residential Solid Waste
Briarcliff Manor	630-750		3900	14%-16%
Bronxville	200-310		3970	5%-7%
Croton-on-Hudson	502		4900	9%
Eastchester	900		16,840	5%
Irvington[1]	490-880		3770	12%-19%
Mamaroneck (Village, Town)	2000		19,500	9%
Mt. Pleasant[2]	950	composted	13,350	6%
	450	piled (bags)	13,350	3%
	1400	Total	13,350	9%
New Rochelle	4900		38,620	11%
North Salem	90		1850	5%
Pleasantville	220		3630	6%
Scarsdale[3]	3150	Fall	12,270	18%
	1150	Spring	12,270	7%
	4300	Total	12,270	25%

Note: Figures are for local governments which kept records on the amount of leaves diverted from residential solid waste. Where the local government had not measured or estimated leaf volume, a conversion of 9 c.y./ton for vacuumed leaves and 5 c.y./ton for more compacted leaves was used. The actual amount of Fall leaves is higher than these figures, since an estimated 5%-20% of the Fall leaves remained in the residential solid waste stream; most local governments reported the level as 20%. The figures in the right-hand column are derived by dividing amount of leaves diverted by the sum of solid waste delivered and the amount of leaves diverted. Estimated 1988 residential solid waste generation figures are assumed to be similar to available 1987 figures.

1 In addition, 400 tons of woody yard waste, for total 1988 yard waste diversion of 20%-27% of residential solid waste.
2 In addition, at least 950 tons of woody yard waste, for total 1988 yard waste diversion of at least 15% of residential solid waste.
3 In addition, 730 tons of woody yard waste, for total 1988 yard waste diversion of 29% of residential solid waste.

($3-$8/ton), saves tipping fees paid to the County ($17/ton), reduces soil amendment expenditures ($8-$10/cubic yard), and, in the case of home composting, also reduces collection costs ($4.50-$20/cubic yard; $60-$108/ton; $4-$8 per resident). Compost processing costs ($4-22/ton) are considerably lower than the costs of alternative disposal options.

From the County vantage point, municipal yard waste composting can yield net savings of $43-$115/ton, depending on whether the avoided cost of new incinerator capacity is included. Municipal yard waste composting saves incinerator processing costs ($28-$34/ton), avoids the transportation costs ($15/ton) of moving leaves from transfer stations to the incinerator, and reduces the strain on incinerator capacity (new capacity: $84-$100/ton). Compost processing costs ($4-$22/ton) are lower than the cost of incineration or disposal outside the County ($84-$120/ton).

Avoided tipping fees are simply one easy-to-calculate cost saving. Local governments have frequently understated the cost savings associated with their own leaf composting programs by calculating avoided tipping fees only. With this observation in mind, Table 3 presents selected examples of how much local governments currently avoid in tipping fees by diverting Fall leaves from the waste stream. We acknowledge that this is only one component of true cost savings by composting.

Transport cost is another component of the overall cost of leaf management. It can be $3-$8/ton, based on information provided by several Westchester local governments. In other words, transport cost can add 15%-30% to the incomplete estimate of cost based on tipping fees. Included in transport costs are the personnel costs for driving to and waiting at solid waste facilities, fuel costs, and equipment depreciation expenses. During Fall, bottlenecks are caused or exacerbated by the large seasonal volume of leaves which enter the County's solid waste system. Personnel expenses are high consequently, since waits of at least one hour are not uncommon at several of the facilities at this busy time of year.

Transport costs are often lower for leaves that are brought to nearby compost sites. Such sites tend to be closer to the leaf collection route than existing regional transfer stations, out-of-County landfills, and the central incinerator. Distance travelled may be less, and waiting time to unload is almost certainly less.

Home Composting:

Yard waste can be composted successfully at home with minimal effort, no bad odors, and no disturbances from animals. Often, yard waste is composted together with food scraps. This works well, provided that meat by-products, which animals seek, are excluded from the compost pile.

Home composting is by far the least expensive leaf management alternative for the County and local governments. It reduces the public costs of collection, transport, tipping fees, and processing. Collection cost is typically the most expensive component of yard waste

TABLE 3

AVOIDED TONNAGE AND TIPPING FEES:
SELECTED WESTCHESTER COUNTY LOCAL GOVERNMENTS

Local Government	Avoided Tonnage	Avoided Tipping Fee
Briarcliff Manor	630-750	$10,710-$12,750
Bronxville	200-310	$3400-$5270
Croton-on-Hudson	502	$8534
Eastchester	900	$15,300
Irvington	490-880	$8330-$14,960
Mamaroneck (Village,Town)	2000	$34,000
Mt. Pleasant	1400	$23,800
New Rochelle	4900	$83,300
North Salem	90	$1530
Pleasantville	220	$3740
Scarsdale	3150	$53,550

Note: These figures are for local governments which kept records on either the weight or the cubic yards of leaves which were diverted from the solid waste stream. Where the local government had not measured or estimated the volume of leaves, a conversion of 9 cubic yards/ton for vacuumed leaves and 5 cubic yards/ton for more compacted leaves was used.

management. Home composting savings could be approximately $40 per participating Westchester household, from an overall public perspective. Stopping the flow of materials at home because they become waste products that require outside handling is gaining recognition as the best yard waste management option. Seattle, Washington, has recognized its cost savings through home composting, and has provided an incentive for residents to compost at home: home composters avoid a $2 per month fee for curbside yard waste collection.

If 20% of the households in a municipality of 15,000 people composted all their own yard waste, the sum of out-of-pocket, short-term costs avoided by the local government would be approximately $22,000 annually. This assumes that 90% of the living units are single-family households, and the municipality collects yard waste and brings it to a transfer station. The County would benefit by avoiding the handling and processing costs it would incur by incinerating 225 tons of yard waste. The short-term savings would be approximately $12,000 annually. Thus, the overall savings, from a public perspective, would be approximately $34,000 annually.

Home composting can be encouraged on more than a strictly economic basis. The values of exercise, recreation, workmanship, science education, and community pride can be identified with home composting.

By actively managing one's own waste, this form of composting may instill in residents a sense of greater responsibility not only for

that waste, but for all their waste. And consequently, residents may develop a greater interest in recycling and other solid waste management issues.

Landscapers can take an active role in promoting and educating customers about home composting. They could distribute literature on home composting to clients--brochures are available at minimal cost from Cornell Cooperative Extension. They could offer to manage a clients yard waste compost pile, as a service or for a fee. They could also inform clients that yard waste may not be collected free of charge as a regular service of the landscaper.

Public Education:

Citizen participation fundamentally determines the success of any curb-side collection program, whether yard waste, recyclable materials, or garbage. The public must be aware of the program and why it is needed, supportive of its goals, willing to adhere to program specifications, and knowledgeable of what those specifications are. It may be possible, in some instances, to combine information about yard waste composting (including curb-side collection and home composting) with information on recycling. The County could provide guidance to local governments on the contents of public education materials on composting and recycling, but responsibility for development of program-specific educational materials is likely to rest with local governments.

Besides mass media, local non-governmental organizations can effectively promote and educate people about composting. These organizations include gardening clubs, neighborhood action groups, community gardens, the League of Women Voters, and landscaping associations. They excel at disseminating information quickly to members, and to contacts in schools and civic groups. They may be willing to give talks, make posters, and conduct door-to-door canvassing at no cost.

Economic and Environmental Benefits:

The economic and environmental benefits of composting leaves are real and numerous, but in some cases, not so obvious. Economic benefits of leaf composting relative to leaf disposal by incineration and landfilling include: avoided disposal fees; reduced transport costs; reduced processing costs; reduced strain on incinerator capacity; and, reduced soil amendment expenditures.

Environmental benefits associated with composting relative to disposal by incineration and landfilling include: improved incinerator combustion efficiency; reduced incinerator emissions and ash; landfill space savings; leaf dump elimination; improved soil fertility and aesthetics from application of compost; and heightened community environmental awareness. Several of these benefits are realized under the assumption that less solid waste needs to be incinerated. In fact, space gained through reduced leaf flow to the incinerator can also be filled by replacement solid wastes. The advantages of leaf composting are summarized in Table 4.

TABLE 4
ENVIRONMENTAL AND ECONOMIC BENEFITS OF LEAF COMPOSTING

Environmental

* Improved incinerator combustion efficiency (higher temperature)
* Reduced incinerator emissions (including particulates, carbon dioxide and nitrogen dioxide)
* Reduced ash from incineration
* Savings of landfill space
* Elimination of leaf dumps
* Improved soil fertility from application of compost
* Improved aesthetics
* Heightened community environmental awareness

Economic

* Avoided or lower tipping fees ($17/ton for IMA governments at County solid waste facilities)
* Avoided processing costs at incinerator ($28-$34/ton)
* Reduced strain on incinerator capacity--
  Possible downsizing of new or expanded incinerator ($84-$100/ton)
* Avoided transport costs to incinerator from transfer stations ($3-$8/ton)
* Avoided transport costs to transfer stations or incinerator from local governments ($15/ton)
* Flexibility in processing methods and equipment
* Reduced expenditures on soil amendments ($8-$10/c.y.)
* Possible revenues from sale of compost ($0-$10/c.y.)
* Reduced collection costs (if home composting)
  ($4.50-$20/c.y., or $4-$8/resident)

Incineration and landfilling of leaves have technical and environmental disadvantages, compared with composting. Leaves have lower BTU values than most solid waste. Thus, the energy released by burning leaves is likely to be less than the energy which could be released by burning other solid waste. Moreover, leaves often are too moist, which can lead to burning at lower temperatures, incomplete combustion and increased emissions. New York State researchers have voiced concern that burning at lower temperatures may leave intact some hazardous substances released or created during burning. Furthermore, some leaves, such as those collected in early Fall, may be too dry to burn efficiently. The ash residue, because it is mixed with noxious residues of other parts of the solid waste stream, ultimately must be disposed in a specially-constructed landfill. In landfills, leaves can produce poisonous gas, leachate, and land subsidence (or settling), as a result of anaerobic decomposition.

Leaves take up valuable space in the incinerator (and landfills). In essence, leaves compete for limited space with certain types of solid waste for which there are no simple alternative disposal options. Since disposal capacity is limited and expensive, available space in the incinerator (and landfills) is best reserved for materials which cannot be reused, composted, or recycled.

Leaf composting should not be confused with leaf dumping, which is illegal. Leaf composting operations are largely environmentally benign. The main concern is brief periods of odor, which may occur during intermittent turning of windrows. Conversely, leaf dumps typically stink, contain solid waste or demolition debris, are fire hazards, are unsightly, and may contaminate nearby water sources. The County is taking steps to ensure that municipalities practice leaf composting, not leaf dumping.

Leaf Processing Costs:

Processing leaves at eight municipal compost sites in the County cost an average of $12/ton of incoming leaves (range: $4-22/ton). Local governments that compost or pile leaves almost always process or store leaves on existing land that they own. As such, land costs are viewed as zero. Most of the local governments that compost leaves process the equivalent of 6000 cubic yards per acre, whether their sites are less than one acre or several acres. The most rudimentary operations typically cost in the $4-6/ton range for incoming leaves. Most of the operations rely predominantly upon a front-end loader for processing, and do not use more expensive, specialized composting equipment. These figures typically include the costs of labor, site preparation and maintenance, equipment depreciation, equipment repair, and transporting and marketing cost.

More intensively managed operations that produce a compost of higher quality tend to cost $21-$25/ton of incoming leaves. This is based on several New Jersey, California, and Michigan cases which use specialized windrow turners, water trucks, and other equipment.

In general, greater use of equipment and labor reduces space and time requirements to make compost. Where land or length of time is limited severely, more frequent turning of the windrows and possibly additional management strategies may be employed to quicken the pace of aerobic decomposition to under ten months, so that finished compost can be marketed before the next Fall's leaves arrive. Where the compost site is available only part of the year, leaves could be composted intensively (although partially) for a few months after Fall collection, and then transferred as mulch to users in April.

Several Westchester local governments expressed interest in sharing processing equipment--especially a shredder or screen--and marketing assistance. Moderate interest was expressed in using a sophisticated windrow turner. We expect that local governments will continue to rely primarily on their own front-end loaders to complete most of the tasks associated with windrow leaf composting. The County could schedule periodic visits for its equipment to municipal or inter-municipal sites. Where the windrow turner is used, additional shredding would not be a high priority; screening still may be desirable.

Compared with a single centralized or a few regional sites, inter-municipal sites would result in reduced transport costs. Local municipal sites would yield even greater transport savings. Transportation costs to existing transfer stations were found to cost municipalities $3-$8/ton.

Croton-on-Hudson Research and Demonstration Program:

A 1.5 acre pilot composting facility provided experience to Westchester County and local government officials about how to operate a leaf composting project. This facility, located at the closed Croton Point Landfill in the Village of Croton-on-Hudson, was operated by County personnel with technical assistance provided by staff from Cornell University. Detailed economic analysis revealed that annualized processing costs would be within the expected range for an intensively-managed leaf composting facility.

The overall financial cost savings associated with diverting 502 tons of the Village of Croton-on-Hudson's Fall 1988 leaves from the County's solid waste system to the pilot composting facility is approximately $26,500-30,500[4]. If the Village had processed the leaves itself and avoided the purchase of compost substitutes by using all finished compost on Village projects, the split in savings would be: Village, $11,200-$15,200; County, $15,300. The County's cost saving

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[4] This figure would be much higher if one used in calculations the expected avoided marginal cost of future incinerator capacity of $84/ton, as derived by a consultant to the County, or the cost of shipping solid waste outside the County, which can be $110-120/ton. Either would be a proper figure to use in an economic analysis of avoided costs. The estimate here uses the more direct financial cost of incinerating solid waste after it arrives at the facility, approximately $34/ton.

is the avoided incremental processing cost, valued for this analysis at $34/ton. The Village's cost savings would be:

* TIPPING FEE		$ 8,530
* TRANSPORT		$ 4,170
--Labor	$ 2,810	
--Fuel	$ 240	
--Equipment and Maintenance	$ 1,120	
* PURCHASE OF COMPOST SUBSTITUTES		$10,000
* PROCESSING COST	$ 7,500	- $11,500
TOTAL	$11,200	- $15,200

Home composting was not actively promoted by the Village. In addition to the avoided costs described above, home composting would have reduced overall leaf collection costs. If an average household had composted its leaves at home, the cost of leaf collection would have been reduced by an estimated $15.30 per household.

Comparative Costs: Composting and Incineration:

The expected minimum cost of incinerating the estimated 24,000 tons[5] of Fall leaves that are not diverted from the incinerator is at least $2 million annually (based on a cost of $84/ton), and could be closer to $2.5 million. By comparison, if composted on land available at no additional cost, the expected maximum cost would be $600,000 annually ($25/ton).

Marketing: Products and Approaches:

Marketing concepts are fairly new to yard waste management. The only alternative to marketing is disposal--yard waste will be generated regardless of whether a market exists. In this respect, a producer or collector must find a use for yard materials, often with little or no concern for remuneration, or else they will indeed become solid waste.

Yard materials produce three general types of marketable products: compost, mulch and wood chips. Compost is primarily valued for its ability to condition, stabilize and improve soils. Compost improves the organic matter content of soils, contributes to the chemical and physical properties of a fertile soil, and enhances plant growth. Mulch is primarily valued for its ability to retard weed growth, preserve water retention in soil, reduce soil temperature fluctuations, and provide structural support for plants. Wood chips can be used as boiler fuel, a bulking agent, or a product with similar uses as mulch.

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[5] Based on multiplying 67% (estimated percentage of IMA leaves still in waste stream) by 510,000 tons of IMA solid waste incinerated by a conservative estimate of 7% leaves in that solid waste. Leaves contained in the additional 147,000 tons of solid waste delivered to the incinerator by non-IMA members are not included in the calculation.

Local governments should not expect to make a profit by producing compost, mulch or wood chips. The economic benefits they receive come from adopting a lower cost approach to yard waste management. Although such yard products can command a market price, such considerations do not alter the basic precept of avoided costs of disposal alternatives.

There are several ways to distribute the compost, mulch or wood chips. Depending on market demand, they can be sold for cash or for in-kind services, given away free to customers who pay their own transport costs, delivered free to customers (with the local government paying the transport costs), or sold at negative cost (the local government pays the customer to take the materials). Distribution decisions include who will market what final products in what form and where, whether they will be given away, sold, or both, and what restrictions apply. Table 5 summarizes distribution methods. Each system can work well under certain circumstances, depending on goals and administrative, logistical and financial constraints.

Nearly all of the finished compost currently produced at Westchester municipal sites is not shredded or screened, and is given away free to residents, landscapers, nurseries, local governments, and community groups. Internal use by local governments can serve as a major market. Local governments use this yard product for general landscaping around municipal buildings, in parks, in golf courses, in athletic fields, as landfill cover, for flower and tree planting, and along roadside shoulders.

Demand for yard products like compost and woodchips is expected to meet potential supply, provided that local governments and the County promote use by local governments and residents, and seek private markets. Most local governments have found sufficient users for their compost. Others may need to publicize better the availability of compost, or to upgrade the quality of the product through shredding or screening. The market for such products tends to be local, due to high hauling costs.

Marketing: Initial Steps:

With the likelihood of several compost programs developing and expanding in the County, the initial goal is to ensure that compost products move through composting sites in a timely manner, so that processing bottlenecks are avoided. The County (and some local governments) could plan a marketing strategy over a few years. In the first year, efforts could be made to start composting operations, and simply to make the end products available to anyone who would take them for free. Large potential recipients could be contacted, ideally before leaves are collected, both to inform them about the availability of the end products and to assess their interest. They could be encouraged to test the products, report on their level of satisfaction, and to identify their product specifications. By the second year, assuming favorable response, compost products could begin to be sold in bulk to large buyers. Once customer loyalty is established, quality assured, and supply guaranteed, prices might be able to be raised. It should be kept in mind that aggressive compost sales likely will only

TABLE 5
MARKETING OF MUNICIPAL YARD WASTE PRODUCTS

I. BY LOCAL GOVERNMENT (most common)

Location:
- Compost site (most common)
- Recycling drop-off site
- Community garden
- Delivered to customer

Products:
- Finished leaf compost (most common)
- Leaf mulch
- Finished leaf compost mixed with grass or sludge

Form:
- Bulk only (most common):
  - Not shredded or screened (most common)
  - Shredded, not screened
  - Shredded and screened
- Bulk and bags (unlikely in bags)

Charge:
- Free to all (most common)
- Free to local government and residents; charge to private sector

Restrictions:
- None: First-come, first-served. (most common)
- Preferential Access: (1) local government; (2) local residents; (3) those who sent yard waste to site (other local governments, private sector)
- Limits on amount taken by one individual or company.

II. BY INDEPENDENT CONTRACTOR

Location:
- Contractor's own site
- Compost site
- Horticultural stores

Products:
- Finished leaf compost
- Enhanced topsoil

Form:
- Bulk or bags (most common)
- Bulk only:
  - Shredded and screened (most common)
  - Shredded, not screened
  - Not shredded or screened
- Bags only:
  - Shredded and screened

Charge:
- Prices depend on: (1) Quality (shredded, screened); (2) Quantity (bulk, bags); (3) Additives (sand, nitrogen, other)

Restrictions:
- None

reduce processing costs, but not cover them, due to a 65%-85% reduction in volume of outgoing product compared with incoming product.

Survey results suggest that yard waste products could be marketed in bulk to green industries; most appear willing to pick up the items at the composting site. The high demand months of April, May, September, and October suggest that 16 month-old finished compost and 4 month-old leaf mulch could be marketed starting in April, and 8 month-old finished compost could be marketed starting in September. Different leaf processing intensities can be tailored to produce finished compost or leaf mulch during seasonal periods of strong market demand. Generally, leaf compost is of higher value than leaf mulch.

Shredding and screening increases compost's marketability by upgrading its quality and appearance, and can add up to 75% in selling price. By one estimate from New Jersey, the cost of shredding and screening finished compost is approximately $1 per cubic yard of incoming leaves. Locally, end product supply will increase as more of the County's leaves are composted. In order to satisfy potential markets, it would be prudent to shred and possibly screen as much of the finished compost as practicable. A windrow turner provides limited but usually sufficient shredding action.

The County could serve as a marketing agent for compost products generated from County-run regional compost sites and from municipalities who have yet to establish firm markets. In this capacity, the County could help to identify and secure markets for compost products from municipal and regional sites, coordinate marketing activities, and provide information and perhaps technical assistance to municipalities. Technical assistance could include shredding and/or screening services provided, perhaps for a fee, by the County.

Identifying Markets:

Westchester County could solicit private sector interest in compost, mulch and wood chips through advertisements or articles in green industry newsletters and directories of these and other organizations: New York State Turf and Landscape Association, Westchester County Gardener and Nurserymen Association, Southeastern New York Nurserymen's Association, Westchester County Tree Protection Association, Metropolitan Golf Course Superintendent Association, and informal associations of school and grounds personnel. A marketing survey could be sent to all members, based on address lists, to help identify specific potential users and what amounts of what product they are likely to use.

Local governments that seek markets could conduct their own informal survey. A few hours on the phone could yield sufficient information about potential markets. Departments that use large amounts of soil and other organic materials could be asked: What are you paying now for these products, and how much are you using? How interested are you in using organic yard products? After this step, contacts could be made with some large nearby institutions, including golf courses, private fields, country clubs, cemeteries, and

universities. Local governments could contact local landscapers, developers, excavators, sod growers, greenhouses, garden centers, farm suppliers, and nurseries, starting with local ones. Markets tend to be local, due to high hauling costs. Generally, contacts should be made within ten miles of the compost site, and not more than thirty.

Marketing Messages:

Effective marketing techniques help to stimulate demand. Upbeat messages and images should be used always in marketing these yard materials. For instance, the marketed materials--compost, mulch and wood chips--are not "yard waste products," since the materials never technically were wasted. Positive messages should be targeted to fit the audience. To government departments, it could be emphasized how the products may reduce departmental purchase costs of alternatives like peat or topsoil, and that product use lowers solid waste disposal costs. To residents, it could be emphasized how the products contribute to a healthy, productive soil, and mentioned that product use reduces waste disposal costs. To the private sector, it could be emphasized how the products contribute to a healthy, productive soil, which may result in a higher aesthetic quality of landscapes, robust gardens and better media for horticultural plants. Suggested uses and levels of use could be made to all customers.

Market Survey Results:

A marketing survey of green industries (landscapers, nurseries, arborists, horticulturalists) that work in Westchester County was conducted by Cornell University staff at the New York Turf and Landscape Association Conference in January 1989. Table 6 shows the prices of compost, other yard products and competing items that are paid by green industries working in Westchester County, based on the survey results (27 respondents).

Yard Waste Disposal Restrictions: Comparative Examples:

Increasingly, governments are requiring that some types of yard waste be kept separate from trash, and composted. One approach which is likely to become more favored in New York State is the banning of leaves from landfills and incinerators. In New York State, we expect that local and county governments--not the State--will take the lead in passing such legislation. A Broome County law, for example, bans leaves from the County landfill.

Elsewhere, states have taken the lead on yard waste disposal legislation. In neighboring New Jersey, a state law which took effect in 1988 bans leaf disposal in landfills or incinerators--leaves must be composted in a permitted composting facility. In Illinois, a state law which takes effect in 1989 bans leaves from landfills unless the landfill operators agree to compost them. In Massachusetts, the state's goal of 100% leaf composting by 1992 is being supported by $7 million in local grants. In time, other yard wastes in addition to leaves may be banned from landfills in several states, and the only yard waste accepted by incinerators may be wood.

TABLE 6
PRICES OF COMPOST PRODUCTS AND COMPETING ITEMS PAID BY GREEN INDUSTRIES IN WESTCHESTER COUNTY, 1989

PRODUCT	PRICE RANGE	AVERAGE PRICES	RESPONSES
Topsoil	$18-35/cu.yd.	$28/cu.yd.(median)	22
Peat	$9-15/bale; $1-3/cu.foot	$1.50-2.00/cu.foot (most responses)	14
Dried Manure	$2/40 pounds; $2/cu.yd.; $10/bag	--------	3
Turf Top Dressing	$30/cu.yd.	$30/cu.yd.	1
Wood Chips	No Cost; AND $15-40/cu.yd.	No Cost; AND $25/cu.yd.	3 14
Bark Mulch	$11-27/cu.yd.	$20-22/cu.yd (most responses)	11
Pure Leaf Compost	$10/cu.yd. (bulk)	$10/cu.yd. (bulk)	1
Compost/Fertilizer Blend	$0.20/pound	$0.20/pound	2
Compost/Soil Blend	$35/cu.yd.	$35/cu.yd.	1

Conclusions:

Yard waste composting as a solid waste management strategy is economically and financially feasible throughout Westchester County. An overall yard waste management strategy should begin with promotion of home composting of all yard waste and concurrent municipal leaf composting, and progressively add brush and wood chipping, and incorporation of grass clippings with leaves for composting. Economic, administrative, and logistical factors suggest that local governments promote home composting and establish municipal composting sites within their own jurisdiction, or arrange with a neighboring local government for access to a composting site. The County could purchase specialized yard waste processing equipment, and schedule its use at local government composting sites.

Several options could be used to reduce Westchester County's waste stream well beyond the percentage reduction it will realize through county-wide leaf composting: leaving cut grass on the lawn, home composting of grass clippings with other organic materials at home, large-scale composting of grass clippings with leaves, and chipping operations for woody yard waste.

Regional composting sites could conceivably be developed as a related package in an overall yard waste management strategy. Two or three facilities that could process a total of 50,000 cubic yards of incoming leaves by Fall 1990 would require a total of 20-30 acres, including buffer zone. Most potential regional sites identified so far are in underused portions of County parks. High transport costs and lengthy transit time might render regional sites unpalatable or unfeasible for several municipalities. Long-range planning for regional composting facilities could include green industry yard waste.

Municipalities and the County could consider distributing most of their yard waste products in bulk to the private sector. Product upgrading (by shredding and screening) will increase marketability and sale price. The County could serve as a marketing agent for compost products generated from County-run regional composting sites and from municipalities that have yet to establish firm markets.

Because the cost of disposal is not covered fully by the current tipping fee, economic signals point only mutedly to composting as the most efficient management option for yard waste. The actual operating and capital expenses for solid waste disposal may be five times higher than the tipping fee set by the Inter-Municipal Agreements. In effect, the County subsidizes local governments for the costs of solid waste disposal[6]. Economic analysis suggests that if local governments were faced with substantially higher tipping fees at the incinerator or

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[6] The difference between the $17/ton tipping fee and the actual cost of disposal is made up by a County solid waste district tax. This tax is levied against the real property in the Westchester County Solid Waste District, which includes all of the local governments that have signed Inter-Municipal Agreements (IMAs) with the County.

transfer stations relative to compost facilities, then they would have a stronger incentive to keep yard materials out of the waste stream.

The potential financial cost avoidance associated with home composting (approximately $40/household (yard waste only, no food waste), from a public perspective) would suggest that a small, residential local government with mostly single-family units could provide brochures on home composting to every household, advertise and publicize in available media, and sponsor backyard composting workshops for interested residents in cooperation with the local Cornell Cooperative Extension office and local community groups. A leading example of aggressive support for home composting is the Seattle metropolitan region, where local and county governments have given economic incentives for individuals to compost at home, have distributed how-to literature, actively publicize home composting as good citizenship, have hired personnel to promote home composting, and are planning to distribute home composting vessels. The County could work more closely with Cornell Cooperative Extension and other organizations, such as landscaper groups, to promote home composting. For example, the County, perhaps in association with other organizations, could develop a home composting demonstration site as a public education device, and encourage landscapers to educate their customers about home composting.

Finally, we conclude that windrow composting provides great flexibility. This intangible benefit can have important economic effects, especially in a volatile regulatory and economic climate. Relative to other yard waste management options, windrow composting does not lock decision-makers into assumptions and sunk costs based on existing technology. This flexibility allows managers to take better advantage of additional information as it becomes available, and to respond effectively to changing circumstances.

Home and municipal composting are demonstrated, inexpensive, and environmentally beneficial techniques for managing a large portion of the solid waste stream. Over the next few years, we expect composting to enter into its accorded priority position in the list of solid waste management options.

Other Agricultural Economics Extension Publications

No. 89-19	Dairy Farm Business Summary, Eastern New York Renter Summary, 1988	L. Putnam S. Smith
No. 89-20	Managing for Success: A Workshop for Dairy Farm Managers	G. Hutt R. Milligan J. Kauffman III E. Claypoole
No. 89-21	Facilitator's Guide for PRO-DAIRY Workshops	G. Hutt R. Milligan J. Kauffman III E. Claypoole
No. 89-22	Management Resources	G. Hutt R. Milligan J. Kauffman III E. Claypoole
No. 89-23	Milk Production Records for Management Control	S. Telega G. Hutt
No. 89-24	Farm Management Planner	G. Hutt S. Telega
No. 89-25	Management Control Clinic	G. Hutt J. Kauffman III R. Milligan
No. 89-26	Cornell Cooperative Extension Farm Business Management Program Guidelines, Suggestions and Resources	S. Smith W. Knoblauch G. White
No. 89-27	Budgeting Data for Limited Resource Dairy Farms, New York	R. Murray-Prior B. F. Stanton
No. 89-28	Milk Quality, A Pro-Dairy Management Focus Workshop for Farm Managers -- A Facilitator's Manual	R. A. Milligan
No. 89-29	Milk Quality, A Pro-Dairy Management Focus Workshop for Farm Managers -- A Participant's Guide	R. A. Milligan