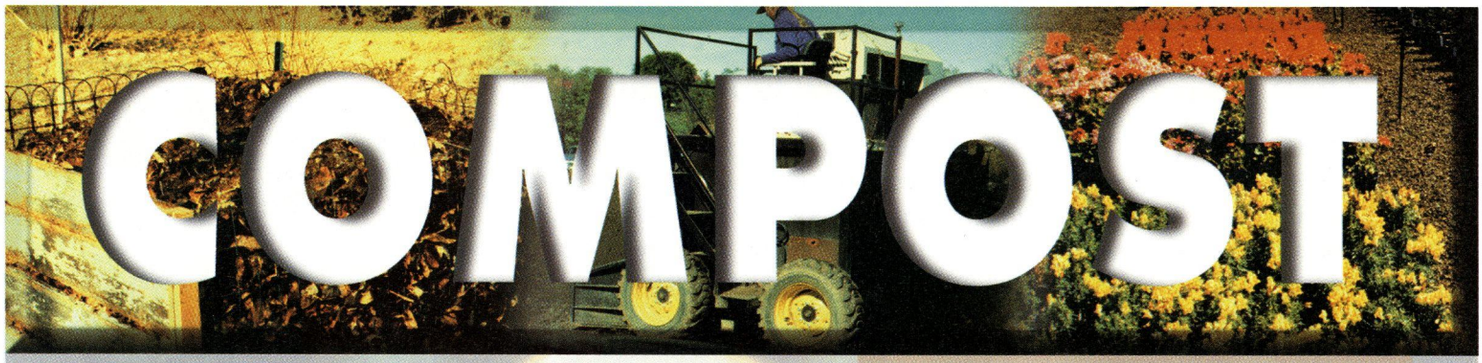

WHAT IS IT and WHAT'S IT TO YOU?

Q. Is compost a peat?

A. NO. Peat is harvested from bogs and dried. Peat is formed over long periods of time by the decomposition of plant materials - - into a carbonaceous form. Peat is a non-renewable, limited resource material, used mainly by the nursery industry as a soilless potting medium.

MATURE COMPOST IS used in place of peat. It gives plants an advantage in increased nutrients and water availability, and reduced disease pressures.

Q. Is compost a mulch?

A NO and YES. Mulch can be either an inorganic or organic ground cover. Mulch can be pebbles, straw, shredded paper, bark, wood-chips, plastic, etc., that helps to retain moisture. Compost can be used as a high quality mulch, especially around new transplants.

MATURE COMPOST CAN BE used as a mulch. Its slow release of nutrients to the soil gives transplants increased protection and nutrients, and water availability near the roots.

Q. Is compost a soil?

A. NO. Soil is the uppermost layer of the earth. Soils are composed of various proportions of sand, silt, clay and small amounts of organic matter.

MATURE COMPOST IS a complex organic material that has been transformed into a stable humus by microorganisms.

Q. Is compost a chemical fertilizer?

A. NO. Chemical fertilizers are inorganic compounds, composed of specific proportions of nitrogen, phosphorus, potassium (and sometimes other nutrients), that are soluble and readily plant-available. Commercial fertilizer contains no organic matter.

MATURE COMPOST IS, in part, an organic mixture of plant nutrients that are released slowly at a rate that is compatible with uptake by plant roots.

Q. Is compost a manure?

A. NO. Manure is animal waste often mixed with bedding or sludge, and containing nutrients, weed seeds, and potential disease organisms. Raw or partially processed manure is not stable and can release nutrients (e.g. nitrogen, phosphorus) at less predictable rates than compost.

MATURE COMPOST CAN BE produced from manure feedstocks and combined with bedding, leaves, chips or other carbon bulking agents. Proper composting destroys weed seeds and potential disease organisms.

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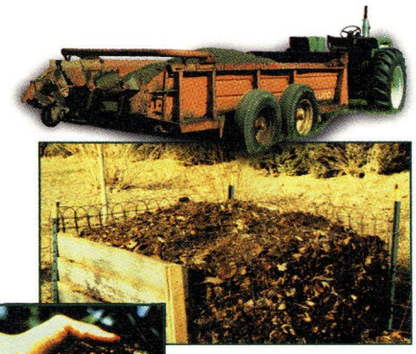
Q. Then what is compost and how is it made?



Backyard compost bin.

Mature compost.

A. MATURE COMPOST IS a stable humus material created by: combining organic wastes (e.g. yard trimmings, food wastes, manures) in proper ratios into piles, rows, or vessels; adding bulking agents (e.g. wood chips), as necessary, to provide air space; controlling temperature, moisture and oxygen to achieve accelerated decomposition; and allowing the finished material to fully stabilize and mature through a curing period.

Decomposition is performed by naturally occurring microorganisms (e.g. bacteria, fungi) that utilize the organic materials for their food and energy sources. Proper primary composting involves temperatures between 110 and 150°F, moisture content between 50 and 60%, and adequate oxygen for the microbes. It is complete when pile temperatures decline and remain below approximately 105°F. A subsequent curing period of 2 to 6 months is required for the compost to mature, after which it will not overheat or produce unpleasant odors during storage, and can be beneficially used.

Q. Whose friend is compost?

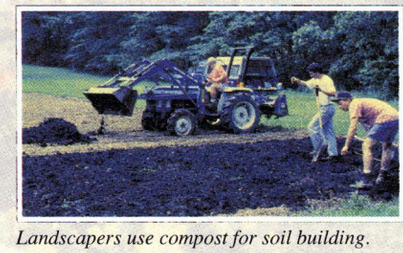
Windrow turner - mixes and aerates compost.

A. MATURE COMPOST IS the farmer's, gardener's, homeowner's, landscaper's, and nursery operator's best friend. Compost provides multiple benefits as a soil amendment, potting mix supplement, and mulch.

BENEFITS OF MATURE COMPOST

Soil/Plant improvements

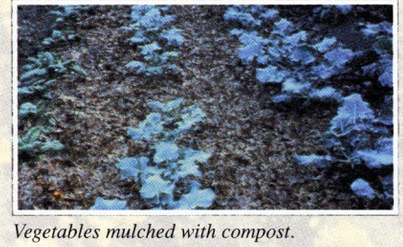
- Improves soil structure
- Reduces soil compaction and crusting
- Increases ease of cultivation
- Improves water infiltration and drought tolerance
- Increases microbial and earthworm populations
- Improves nutrient holding capacity
- Reduces fertilizer requirements
- Improves root growth and yields
- Protects plants from disease



Landscapers use compost for soil building.

Pollution Prevention / Remediation

- Prevents erosion of embankments, roadsides, and hillsides.
- Binds heavy metals in contaminated soils.
- Degrades many pesticides.
- Absorbs odors and degrades volatile organic compounds.
- Diverts organics from landfills into compost, reducing waste burden and methane production.



Vegetables mulched with compost.

For more information, contact your local Cooperative Extension Office or the ORCC (@VRA 703/549-9263).

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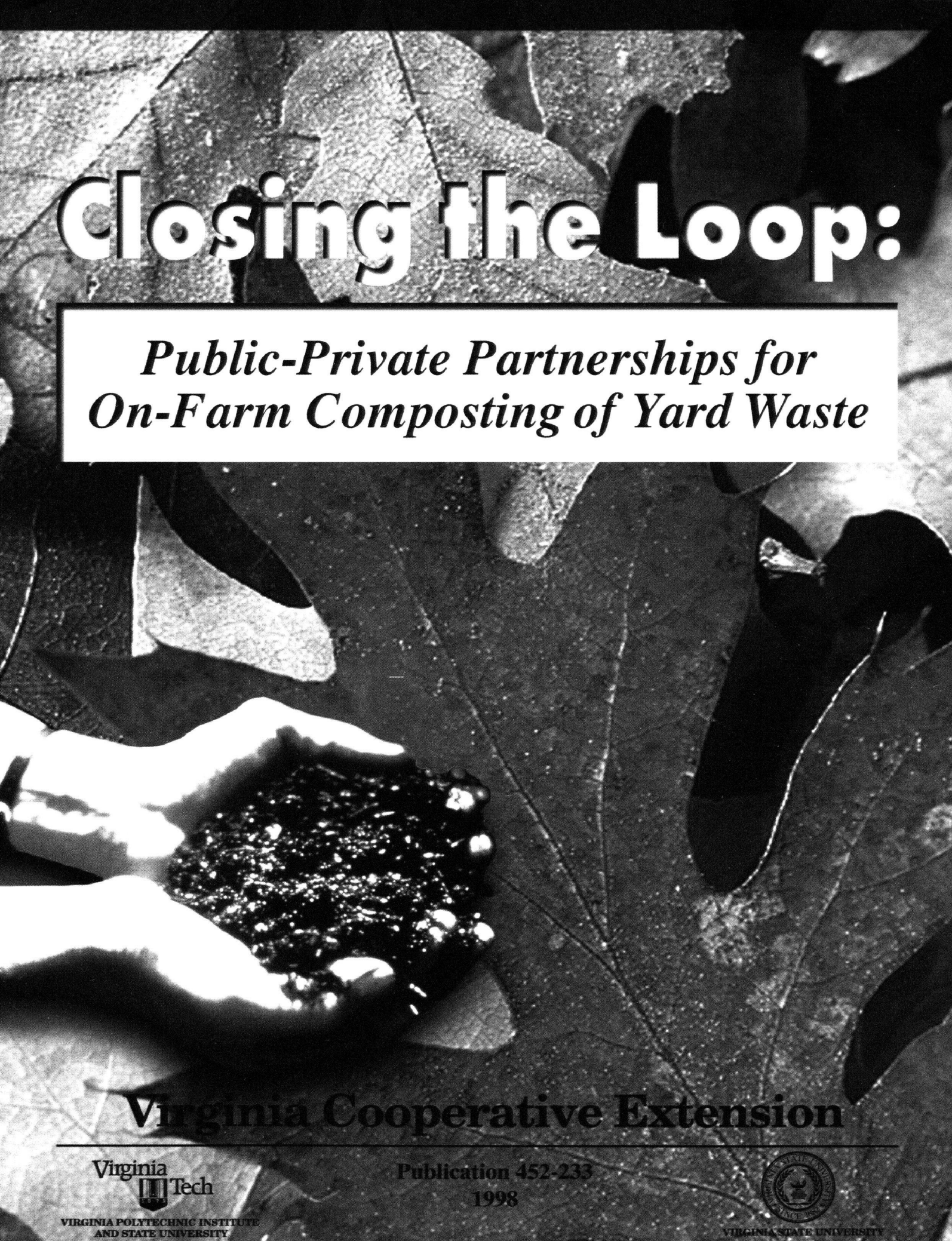

Closing the Loop:

Public-Private Partnerships for On-Farm Composting of Yard Waste

Virginia Cooperative Extension

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Closing the Loop

Public-Private Partnerships for On-Farm Composting of Yard Waste

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CONTENTS

I. INTRODUCTION / PURPOSE

Organic residuals resulting from yard care and agriculture are often disposed of through landfilling despite their potential as soil amendments and soilless media. Composting these materials can create products that have agricultural, economic, and environmental benefits. This publication is designed for waste managers, community planners, recycling and environmental coordinators, and others interested in waste reduction and recycling. It is a resource for communities seeking to implement composting as an alternative to current waste management practices. Strategies for building public-private collaboration, providing education, transferring technology, and for creating an efficient system of residuals delivery and compost production are explained. The sections that follow:

a) make the case for a partnership program,

b) identify key program elements and explain how to establish them,

c) address regulations, and

d) provide three Virginia case studies.

II. THE CASE FOR ON-FARM COMPOSTING AS A WASTE MANAGEMENT OPTION

A. STATE OF WASTE MANAGEMENT IN THE SOUTHEAST

1. Municipal Wastes

The Southern region states of Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Tennessee, and Kentucky generated an average of approximately 112.5 million tons of solid waste per year in 1995 and 1996 (Goldstein, 1997). Virginia's contribution to this total in 1996 exceeded 8.5 million tons (Goldstein, 1997).

Seventy-seven percent of the solid waste generated in the Southern region states was landfilled at a cost of $2,252,000,000 in 1996 (Goldstein, 1997). Landfill disposal, at an average tipping fee of $35/ton, costs Virginians more than $300 million per year. Alternative uses for solid wastes can offer reduced costs to Virginia taxpayers.

Yard waste, which is "decomposable waste materials generated by yard and lawn care and includes leaves, grass trimmings, brush, wood chips, and shrub and tree trimmings (<6 inches in diameter)," comprises about 15-17 % of the solid waste stream (May and Simpson, 1990). Five Southern states, responding to a 1996 national survey (Steuteville, 1996), generated between 233,000 tons (South Carolina) and 1.79 million tons (Florida). Virginia's most recently available figure for recovered yard wastes of 354,000 tons in 1993 (Steuteville, 1996), represents only 4 % of the total waste generated that year. Thus 1.1 million tons of yard waste is being landfilled in Virginia. At $10.50 to $35 per ton in tipping fees, the cost to Virginia is between $11 million and $50 million dollars annually.

2. Agricultural Wastes

It is estimated that the Southern region states annually generate more than 15 million tons of animal manures that can realistically be collected (NASS, 1993; VADCR, 1993; USDA/SCS, 1992; Hegg and Gerwig, 1997). Virginia produces approximately 4.17 million tons per year (Hegg and Gerwig, 1997), most of which is spread on crop, pasture and hay fields. To protect aquatic ecosystems from nutrient loading, manure should not be applied during periods of low crop nitrogen (N) uptake when leaching and runoff may transport N or phosphorus (P) in ground and surface water. As an alternative to direct application, stockpiled manures can be composed on-farm with yard waste and applied when conditions are favorable or transported to nutrient deficient areas.

B. ON-FARM CO-COMPOSTING OR LEAF MULCHING

1. What is Compost and How is it Made?

a. What is compost?

Compost is the end-product that results from the controlled, aerobic decomposition of plant and/or animal waste material, such as leaves, grass, animal manures, food and food processing wastes, peanut hulls, and paper. Compost is very different from the raw materials used to create it. This finished product is a mixture of complex compounds that is free of unpleasant odors, can be stored for long periods of time, and is easy to handle. It has a high humus content, which makes it less dense than soil, and holds more nutrients and water than soils. These attributes make compost a valuable soil and potting media

[1]*Code of Virginia. Vegetative Waste Management and Yard Waste Composting Regulations. 9 VAC 20-101-10 et seq.*

amendment for improving the chemical and physical properties of the material to which it is added. Compost users include nursery and greenhouse operators, landscapers, gardeners, farmers, homeowners, grounds maintenance personnel, golf course managers, and land development contractors.

b. How is compost made?

Compost is created by combining organic wastes in proper ratios into piles, rows or vessels; adding bulking agents (e.g. wood chips) as necessary to provide air space; controlling the temperature, moisture and oxygen to achieve accelerated decomposition; and allowing the finished material to mature through a curing period. Decomposition is performed by naturally occurring microorganisms (e.g. bacteria, fungi) that utilize the organic materials as food and energy sources. The primary end-products are carbon dioxide, water, and the humus material called compost. Proper active composting requires temperatures between 110 and 150°F, moisture content between 50 and 60%, and adequate oxygen for the microbes. It is complete when pile temperatures decline and remain below 105°F. A subsequent curing period of 2 to 6 months is recommended for compost to mature, after which it will not overheat or produce unpleasant odors during use or storage.

2. Benefits of Composting

On-farm co-composting of municipal yard trimmings and agricultural wastes is an alternative to managing either waste independently. It can compete economically with landfill disposal. Farmers frequently have more suitable land for composting than municipalities or landfills, and special permit exemptions allow them to compost yard trimmings and agricultural wastes less expensively than solid waste compost operators.

3. Benefits of Compost Utilization

The benefits of compost utilization include:

- ✔ Improved water holding capacity, reducing drought effects on plants and allowing them to thrive with less precipitation or irrigation;
- ✔ Improved soil structure and aggregation, promoting better plant rooting and the capacity of agricultural soils to withstand traction and tillage pressures;
- ✔ Increased soil aeration, allowing greater plant root development and biological activity;
- ✔ Improved soil nutrient holding capacity, minimizing leaching of plant nutrients, making them available to plants over broader climate and soil physical conditions, and reducing the risk of water contamination; and
- ✔ Reduced erosion, limiting loss of valuable top soil.

Compost has also been reported to increase soil nutrient concentrations and yields in crop production, increase root growth and plant size in nursery stock, and improve lawns and other turf grass plantings (Gajdo , 1997; Maynard, 1997; Klock, 1997). Reductions in fertilizer applications can also be realized from compost use (Maynard and Hill, 1995; Singh and Amberger, 1995). Properly derived composts can also aid in the control of some plant fungal diseases and some insect pests (Logsdon, 1995, Marull, et al., 1997).

Compost can help mitigate the detrimental effects of some conventional agricultural, horticultural and land development practices. Crop harvest results in the continuous removal of plant nutrients that can be partially replaced by compost. Degradation of soil structure caused by tillage or compaction is effectively counteracted by compost applications. Compost may be used by nursery operations as an alternative to peat, a non-renewable and expensive potting material. Land disturbance resulting in the removal of top soil can benefit from the nutrient and humus content of compost.

4. What is Leaf Mulching and What are its Benefits?

Leaf mulching is the spreading of a layer of leaves on land and using tillage to incorporate them. Mulching is an alternative to landfilling, stockpiling and composting of leaves. The agronomic benefits include reduced soil erosion, improvement in soil structure, and potential increases in crop yield due to added organic matter.

Leaf mulching can also have some disadvantages:

- ✔ Farmers may find large quantities of trash in incoming leaves;
- ✔ Decomposition can be hindered by excessive depths and high moisture content of leaves;
- ✔ Initial immobilization (tie-up) of soil nitrogen can slow plant growth when leaves are incorporated just prior to or during growing season; and
- ✔ Soil temperatures can be suppressed, delaying planting.

When conditions are appropriate and no more than 6 inches are applied and incorporated at a time, leaf mulching is a valuable agricultural practice. It can also benefit waste managers in terms of a lower tipping fee for leaf disposal and reduced transportation costs when destination farms are closer to delivery routes than current disposal sites.

C. SUMMARY

Composting benefits communities by recycling wastes into usable resources; by improving agricultural soils; by providing a local, renewable resource for improving public and private landscapes; by enhancing the local economy through potential business opportunities for compost providers; and by reducing waste management costs. Educational events, new collaborative relationships, pilot programs, and favorable interpretations of, or changes to regulations have allowed many communities to overcome the barriers and create successful on-farm municipal yard waste composting programs.

III. BARRIERS TO ON-FARM CO-COMPOSTING OR LEAF MULCHING AND TO PARTNERSHIP PROGRAMS

There has been minimal effort to recycle municipal yard wastes and manures through on-farm composting or leaf mulching in Virginia. The obstacles include:

1) lack of information,
2) institutionally-based structures and perspectives,
3) local and state regulations,
4) feedstock quality, and
5) public opposition.

A. LACK OF INFORMATION

There is a lack of information about composting and compost utilization. Many waste managers do not know what compost is and the degree to which recycling through composting can affect waste management economics. Agricultural educators may understand on-farm composting technology, but often know little about the opportunities for using municipal as well as farm wastes. Most farmers do not have sufficient understanding of the composting process or awareness of potential off-farm feedstock resources to feel confident about incorporating the practice into their existing systems. Potential compost end-users, including farmers, landscapers, and nursery operators, need more information about the benefits and costs of compost and/or how to use it most effectively before they will employ it in their operation.

B. INSTITUTIONALLY-BASED STRUCTURES AND PERSPECTIVES

Traditionally, waste managers have focused on disposing of wastes and remain unaware of the positive economic impact of recycling organic materials. There may be no specific individual within a waste management agency designated as a composting specialist, and new responsibilities for already overextended administrators can be difficult to promote. Recycling to create a new resource is a relatively new concept that must become institutionalized for composting to succeed.

C. LOCAL AND STATE REGULATIONS

Regulatory barriers to on-farm composting of yard wastes occur at both the state and local levels and involve questions of process area siting, raw materials, compost quality, and the definition of composting. Many states have a tiered approach to compost facility permitting and classify facilities based on amount and type of feedstocks received. Some states, such as Virginia, provide certain exemptions for agricultural operations as a means to encourage composting.

Farmers in Virginia who receive yard trimmings for composting must have a site that meets minimum acreage limits, buffer zone requirements, and depth to groundwater limits. These regulations can constitute barriers if arbitrarily determined or unreasonably applied. Virginia farmers are limited to composting farm-generated wastes and on-site or imported yard wastes, unless they are granted a Solid Waste Composting permit (cost = $9,700+ engineering fees). In other states, such as Texas, composters using yard waste, manures, clean wood, vegetable materials, and paper as feedstocks are exempt from permitting requirements.

Local zoning officials can also restrict farm-based composting operations if they consider composting an industrial rather than an agricultural activity. Although many local government agencies and offices have recognized composting as an agricultural operation, compost is still identified as a manufactured product under the Agricultural Chemicals Manufactur-

ing section of the U.S. Department of Labor OSHA classification system. This classification has in some cases been the sole determining factor for prohibiting on-farm composting.

Other regulatory restrictions can include limits of truck sizes on county roads and of finished compost. Farmers seeking to sell some of the finished product at the farm may be allowed to offer it in bulk, but not in bags.

D. FEEDSTOCK QUALITY

Trash items, such as glass shards, large stones, plastic bags, and hubcaps, can hinder the composting process, limit end product applications, and be hazardous for the composter. If wastes are collected by vacuum trucks or in black plastic bags, the amount of trash is not visible and can be quite substantial. Some municipalities with separate collection and disposal programs for yard and other solid wastes have converted to clear plastic bags, making it easier for waste collectors to identify unacceptably contaminated bags. Yard waste material delivery contracts between farm operations and waste management entities commonly specify the percentage trash allowed per load (generally 1-2%), and provide for the farmer's right to refuse seriously contaminated loads.

E. PUBLIC OPPOSITION

Neighbors of potential composters who have little knowledge about how compost is produced and of end-product characteristics may oppose a facility due to fear of environmental and health problems. Another misperception is that a composting operation is a waste dump. Others find it objectionable that someone might benefit from the use of their wastes.

IV. PARTNERSHIP PROGRAM FOR YARD TRIMMINGS COMPOSTING (OR LEAF MULCHING)

The steps for pursuing a partnership program for recycling municipal yard wastes to farms are:

A. Assess the need and opportunities for a program;

B. Conduct a pilot project to demonstrate the feasibility of a program;

C. Establish the program - build relationships, establish roles, educate participants, develop contracts and publicize the program;

D. Implement the program - identify and enroll farmers, and establish material distribution and composting support systems; and

E. Conduct complementary public relations activities

Learning from those who have been through the process is an effective way to avoid problems. Investigating the successes, barriers, and lessons, such as those provided in the case studies herein, can save considerable time and resources.

A. DETERMINING THE NEED FOR A PROGRAM

A basic cost/benefit analysis should be conducted to determine whether agreements with farmers can be economically viable. Participation in a partnership program with farmers must be no more expensive to the public authority than to operate the current yard waste management system. Some communities pay a specified fee to waste management authorities regardless of delivery quantity ("put-or-pay" agreements). This cost must be considered when evaluating farmer delivery agreements.

The critical economic factor for most municipalities is the current delivery cost of yard waste to a disposal or stockpile site. Delivery distance or delivery time may be reduced by depositing yard wastes on farms. Expenses that must be quantified include:

- ✔ Operating and annualized investment cost per mile of municipal delivery equipment (dump trucks, vacuum leaf collectors, compactors)
- ✔ Labor costs currently associated with stockpiling / disposal (collection, transport, debagging, etc.)
- ✔ Additional equipment costs, such as grinding, chopping, and loading to manage yard waste
- ✔ Current tipping fees for disposal

Additional costs from a farm disposal program include:

- ✔ Publicizing the program
- ✔ Enrolling and educating farmers and providing them technical support
- ✔ Reaching contract agreements
- ✔ Documenting program performance
- ✔ Removing of foreign material from the yard waste

- ✔ Developingt of contingency plans for alternative stockpiling or disposal if weather conditions impede farm delivery

The worksheets in the Appendix may be used if no established procedure exists for such economic analysis. VCE Publication 452-055, *The Virginia Yard Waste Management Manual* contains a detailed treatment of municipal collection systems and costs.

Farmers may wish to charge a tipping fee for yard waste disposal on their farms. However, many are beginning to learn the benefits of leaf mulching and composting, and are thus increasingly interested in receiving vegetative wastes. They may accept a lower tipping fee in these cases. The potential unexpected savings possible from farm disposal include the avoided costs of transfer stations, chipping/shredding of materials, maintaining stockpile areas, or loading of aged material for citizens.

Recycling of municipal yard wastes through on-farm composting may not be feasible even if desired, because of an adverse community response to a pilot project, unwillingness of waste managers to try something new, a small number of farmers willing to participate in the program and the quantity of material each is willing to receive.

B. PILOT PROJECTS

A pilot program in which a small portion of yard waste is transported to a few farms for composting may aid waste managers in assessing the potential of the program. Roles can be clarified, the time and resources necessary for program administration can be more accurately estimated, and more farmers and citizens can be educated prior to a full-scale program.

Pilot project farmers must be receptive to composting education and to hosting demonstration events at their sites. Feedstock materials should be tested, a proper mix determined, and good process management conducted in order to avoid odors and to create a good quality end-product. Ensuring that farmers receive proper technical support is essential. Both written and visual documentation of the project will benefit its promotion through the media and local community organization activities. Testing the finished product, making those results available, and offering samples can help build program support.

C. PROGRAM ESTABLISHMENT

Steps in establishing a full program include:

1) establishing linkages and defining responsibilities;
2) identifying farmers;
3) educating participants;
4) developing contracts; and
5) publicizing the program.

Securing endorsement for the program (e.g., from regulatory agencies), is important in establishing broad-based support. Commitments must be obtained from agencies, offices and individuals who will be providing resources and personnel for program implementation.

Successful programs have generally had a champion who initiated action and shepherded the concept to the point at which sufficient support existed for the program to move ahead on its own. Program initiation can come from a waste manager, a farmers' group, the area recycling coordinator, a city manager's office, or Cooperative Extension. Establishing and implementing the program can ultimately become the responsibility of one or more individuals who may or may not have been the champion.

1. Roles and Linkages

Each program will be unique. Building effective relationships among various groups and individuals involves identifying common goals, incorporating each participant's agenda to the extent possible, and acknowledging the importance of each role. Some important questions to answer are: Who are the decision-makers / resource providers? Who can potentially implement the program? Within which administrative structure will this program fit?

A potentially valuable element in program establishment is the creation of a task force or project team to carry out the initial steps and to advise, support or conduct program implementation. A second important element is the creation of a network of affiliated individuals and organizations that can help support the program.

a. Project team.

A project team should include: a decision-making representative of the local/regional solid waste management authority;

- ✔ a program field coordinator;
- ✔ the area Cooperative Extension agent, other

agricultural agency representative, or a private composting consultant; and

- ✔ an appropriate representative of the company or agency conducting yard waste collection and disposal.

Individuals responsible for program establishment and implementation should have a basic understanding of on-farm composting. The following primary role descriptions are offered as a guide. Initiators of a program may determine that other combinations of roles and responsibilities are more appropriate.

Program Manager. The Program Manager will be responsible for overall program establishment and oversight. The following important activities may be the sole or shared responsibility of the Program Manager: organize program structure, initiate notification about the program; outline roles, establish collaborative agreements among agencies and organizations, and hire or retain program personnel; collaborate with appropriate Cooperative Extension agent and/or specialist to help prepare informational materials and hold introductory meetings; and provide program oversight, e.g. conduct supervisory activities, receive and process regular reports, manage problems outside the responsibility of program staff.

Field Coordinator. The Field Coordinator holds primary responsibility for program operations. The Program Manager can assume this role if the composting expert is able to provide enough support and the program is intended to be small.

A Coordinator must thoroughly understand the particular constraints farmers may face regarding composting site, equipment and process management. A Coordinator's duties include identifying, enrolling and educating farmers; negotiating contractual arrangements; identifying additional sources for organic waste materials; facilitating understanding of and compliance with regulatory requirements; coordinating deliveries; troubleshooting delivery, quality, and processing issues; facilitating follow-up utilization trials and conducting educational field days; building citizen support; and sharing program information with other interested communities.

Agricultural Agency Representative(s) or Composting Professional. The Cooperative Extension agent or a composting consultant can help create bridges between the public waste management body and the farmer and provide information on composting. Cooperative Extension agents can arrange and conduct farmer meetings at which the Field Coordinator or Program Manager can present the program concept and discuss farmer enrollment, assist in identifying additional composting feedstocks, and provide technical support during program implementation. Other potential individuals for this role are state-contracted nutrient management specialists, Natural Resources Conservation Service (NRCS) personnel, and independent soils/waste management consultants.

Waste Handler. Waste collection and transport is handled either by a waste management authority or an independent contractor. The Waste Handler will be responsible for material delivery to farms and work directly with participating farmers and the Field Coordinator in developing a delivery plan and schedule.

The Waste Handler should also be responsible for ensuring that the yard waste is not unduly contaminated. Refusing yard waste that contains higher than acceptable levels of trash can ensure compliance. Waste collection staff will require education regarding the allowable trash limits. Public education efforts to minimize the trash content of yard wastes are extremely important and can be either the sole responsibility of the Waste Handler or be assumed jointly with the Field Coordinator. Examples of methods to educate the public are: advertisements in local and regional newspapers, and public service announcements on local radio stations about the program and the importance of "clean" yard waste; notices at each yard waste pick up site; and signs on yard waste collections trucks that state the limits on trash percentage and encourage citizen cooperation.

Farmers. Farmer participation on a program team allows farm needs and concerns to be adequately addressed, direct relationships to be established, and other participants to be assured of farmers' commitment to the program. Farmer participation helps ensure their role as partners in an alternative, improved waste management plan, and prevents farms from becoming dumping grounds for city wastes. Furthermore, farmer presence on the program team provides an important link to the larger agricultural community from which additional farmer participants can be recruited.

b. Support network.
Identifying and enlisting the support of additional resource persons such as area Recycling Coordinator(s), NRCS personnel, and representatives of local farmers' organizations and conservation groups can make a program more successful. Such individuals can participate in Program Team meetings and promote the program as an outreach function. The presence of this broader network of informed public personnel, farmers, planners, and others will ensure that the program gets proper support from all corners, and is resilient in the face of shifting political policies.

2. Farmer Identification
Existing networks can be utilized to locate potential farmer participants. Cooperative Extension, NRCS staff, farmer organizations, and state agriculture agencies can assist in identifying potential farmer participants. The program can be advertised through flyers mailed to local agribusinesses, in local agricultural newsletters, through regional offices or chapters of agricultural organizations, and during appearances at agricultural events.

3. Education
Informational meetings and educational events can be held to explain the role on-farm composting can play in a community's yard waste management program and to share the specifics of a proposed plan. Informational meetings generally include a slide or video presentation on the basics of creating compost, the use of the end product, and the economic benefits to the farm and community. Providing handouts to which participants can later refer is beneficial. Educational workshops often include more in-depth treatment of topics such as:

a) the benefits of recycling through composting;

b) the importance of feedstock quality;

c) the logistical considerations of waste delivery;

d) the degree of compost process management required;

e) the expected length of composting time; and

f) the projected quality of the finished compost.

Sharing finished compost samples, offering presentations by successful farmer composters at meetings, and conducting field visits to on-farm composting operations and compost application sites have proven to be effective components of an educational program.

4. Contracts
The administrative structure of yard waste management and the number of farmers participating in a program in any given region will determine the number and nature of the contracts necessary for implementation. All parties exchanging goods, services and/or money will need to be signatories of contracts, memorandums of understanding, or letters of agreement. Where several towns and/or cities are part of a larger waste management authority and collection and disposal costs are borne by those individual jurisdictions, the arrangements may need only be between the local waste managers and participating farmers. The agreement of member jurisdictions may be required when an on-farm yard waste composting program is being instituted by a central waste management authority that handles regional yard waste collection and disposal. Programs have also been established that involve several waste management agencies contracting with a single farmer to compost yard wastes.

A clear concise contract should be offered to potential farmer composters, taking into account individual farm constraints. Such a contract should address issues of:

- ✔ length of agreement
- ✔ quantity, tipping fees (if any)
- ✔ delivery schedule and conditions
- ✔ material quality
- ✔ processing requirements or expectations
- ✔ contingencies
- ✔ assignment of responsibility in the event of damages

Adequate contracts will insure farmers' continued participation in the program and be valuable, if necessary, in resolving issues potentially raised by concerned citizens. Contract issues for compost feedstock delivery and management are addressed in VCE Publication 452-232, *On-Farm Composting: A Guide to Principles, Planning and Operations.*

5. Publicity
Program or Field Coordinators can publicize the program to the community directly and through the support network identified above. Tools that can be utilized include:

- ✔ print and television media
- ✔ notices to business organizations and clubs

- ✔ information leaflets in local utility bills to citizens
- ✔ appearances at public meetings with related agendas
- ✔ presentations to citizens and other groups regularly in search of interesting programs

Developing the materials for these actions is the first step and should include, at the least, creating a simple, single-page leaflet describing the program. Attractive informative educational materials about composting for use in such programs are also available through Cooperative Extension. Including one or more farmers in these events can make the program more real for audiences.

D. PROGRAM IMPLEMENTATION

1. Farmer Enrollment and Education

a. Enroll.

A primary means of enrolling farmers in a composting program is through a meeting(s) co-hosted with Cooperative Extension or an agricultural organization. Including presentations by farmers currently conducting successful composting operations can be particularly effective. Important information to provide at such meetings includes:

- ✔ a description of the proposed project
- ✔ farmer participation options
- ✔ results of any pilot project conducted
- ✔ a summary of the soil and plant benefits of compost
- ✔ the range of land and equipment likely required
- ✔ investment in time and money likely required for successful composting
- ✔ direct economic benefits possible

Successfully enrolling farmers also involves being able to address concerns such as regulatory requirements, liability issues, and the protection of one's farmland, roads and fences. Assuring farmers of technical support in compost production and/or assistance in reporting tasks can serve as additional incentive to enroll. In enrolling, however, farmers must understand that they will be expected to responsibly manage yard wastes and other wastes in producing compost. Learning through case studies can help farmers better determine whether or not to participate in a program.

b. Educate.

Composting is a process that must be adapted to a specific farming operation; therefore, farmers must learn how to plan and conduct an operation. Farmer participants should be informed about the structure and program-related activities of the waste management authority team. This knowledge will increase farmers' understanding of the constraints under which that authority operates, thus helping promote tolerance for unavoidable delivery delays or other problems.

Some farmers may already have composting experience, while others will have had none. Asking farmers what they already know can help determine training components. Composting myths may have to be unlearned. Existing educational materials can be used and Cooperative Extension personnel can be called upon to provide or assist in educational workshops. Field days and demonstrations are effective complements to classroom sessions. The following are specific examples of educational program strategies and activities:

- ✔ provide an in-depth training workshop in:
  - siting (including accessibility, slope, proximity to water supply)
  - recipe-building (including example problems in recipe calculation)
  - efficient operation - troubleshooting (including practice in solving composting process problems)
- ✔ provide a resource and record-keeping notebook
- ✔ demonstrate:
  - feedstock volume-to-weight relationships
  - volume (and/or weight)-to-land area relationships
  - proper vs. improper windrow or pile construction (size of pile, importance of mixing, pile layout on site, buffer zones)

Copies of pertinent regulations and ordinances should be provided to the participants and be supplemented by presentations from local planning and zoning officials in cases where local ordinances may be complicated.

2. Material Distribution System

A schedule for efficient, flexible material distribution must be developed that addresses: 1) raw material availability; 2) timetables for material receipt; and 3) weather considerations. Lines of communication for

material distribution to farms should minimize steps and maximize flexibility. Problems can be avoided if farmers coordinate directly with a collection manager or hauler.

Many things can happen which may disrupt the expected sequence of activities on farms. Equipment normally used to manage delivered materials can break down or be needed for an unexpected task. Farm roads are more subject to effects of heavy rains than city or county roads and can become impassable.

Farmers may need to stockpile farm or municipal wastes in order to maximize composting efficiency or reduce detrimental environmental effects. For instance, an adequate supply of materials high in carbon, such as livestock bedding or wood chips, must be on hand to promptly mix with a large delivery of grass to avoid the generation and release of odorous gases.

3. Composting Support System

Important elements of a composting support system include:

a) assistance in identifying and procurement of co-composting feedstocks;

b) technical support and troubleshooting;

c) complaint resolution; and

d) regulatory-related support.

a. Additional compost feedstocks.

The Field Coordinator can assist in finding and developing off-farm compost feedstocks and can establish more efficient delivery systems for a group of farmers than a single farmer might arrange on his/her own. Additionally, a representative of a recognized program may have greater success in establishing a relationship with an organic waste generator/hauler who might be wary of an individual farmer's overtures.

b. Technical support and troubleshooting.

Appropriate technical expertise should be available at the beginning of a program. Recruiting the support of Cooperative Extension agents and specialists or retaining a composting consultant on an as-needed basis is advisable. The Field Coordinator or Program Manager must be accessible when problems arise.

c. Complaint resolution.

Neighbors may discover that nuisances such as odors, truck traffic, and noise are worse than expected. Citizen complaints must be handled in a proactive, professional, and sensitive manner. It is the responsibility of the Field Coordinator or Program Manager to help farmers deal with irate citizens, because an unresponsive farmer can irreparably damage a program that is suffering from negative public sentiment.

d. Regulatory-related support.

Project managers can work with state agencies to assist with required annual reporting. Likewise, state agency and local government inquiries about the program can be directed to the Program Manager, who may be more at ease interacting with bureaucracies than are farmers.

E. COMPLEMENTARY PROGRAM ACTIVITIES

1. Program Support

Greater program success will be likely with regular documentation and review of activities and with consistent efforts to maintain a positive profile in the community.

a. Program documentation and review.

Reporting and information sharing by Project Team members is necessary for effective program management. Documentation of a program should include:

a) line-item program costs and budget status;

b) farmer feedback;

c) finished compost quality;

d) identified problem areas; and

e) recommended changes.

The Program Manager can incorporate information and recommendations gathered through reports and from meetings with the Project Team in making modifications that improve program efficiency. Thorough documentation is also important in establishing long-term support for a program.

b. Maintaining a positive community profile.

Program viability can be promoted by activities that maintain a positive profile in the community. Informing citizens about the destination of their yard waste and the benefits that recycling provides can be conveyed through program media updates, field day events at farm composting facilities, and information booths at community events. Field days can be very effective if they involve demonstrations of compost production, the results of its use, and the availability of finished product.

2. Compost Use Demonstration Programs

Compost use demonstration programs are critical to the success of the composter because the economic benefits of compost have not yet been well quantified and consumers need to be educated about the benefits of compost use. Composters who produce material for their own use must be able to determine its value to justify employing the time and resources to continue to compost. Potential commercial composters must be convinced of the economic opportunities that exist for marketing of the product before they will make an investment in a composting enterprise. Potential consumers of compost must understand its value before they will purchase the material in lieu of commercial fertilizer and/or other organic waste materials (e.g., biosolids, manures).

Uses of compost include:

- ✔ growing media component for horticultural use
- ✔ soil amendment for silviculture (reforestation), turf establishment, vegetable and row crop production, planting beds, field nursery production and soils disturbed by mining or other activities
- ✔ growing medium for sod
- ✔ garden and plant mulch
- ✔ blended topsoil component
- ✔ soil mulch for erosion control
- ✔ livestock or poultry bedding material
- ✔ backfill amendment

Compost use studies should demonstrate both agronomic and economic benefits to be effective. Enhancing soil properties and benefiting environmental quality are worthy goals of compost use, but they are not worthwhile unless such use is proven to be economically feasible. Results of compost use studies should be publicized both via field days and in printed study summaries that can be disseminated at field days, through Cooperative Extension, NRCS, and local Soil and Water Conservation Districts, and at the place of sale of compost.

Experimental or demonstration comparisons can be conducted in the field, in greenhouses, on landscapes, or at facilities housing livestock or poultry. University scientists or agency personnel can assist in the study design; collection of soil, water and/or plant samples and their analysis; and statistical analysis of the data. Studies that provide visual comparisons of previously proven effects as well as those that yield new statistical results are both valuable .

The data that should be collected and the acceptable analysis values will vary depending on the intended use of the compost. Compost for use as a soil amendment by a farmer should possess a high organic matter (organic C) content and high concentrations of essential plant nutrients. Physical properties associated with water-holding capacity are more critical for compost intended as a soilless container medium. Landscape erosion control materials should be able to absorb water, but they should not have high concentrations of nitrogen and phosphorus, which could leach from the material and be a potential source of surface water contamination.

The most important parameters of compost include:

- ✔ pH
- ✔ soluble salt concentration
- ✔ nutrient concentration and availability
- ✔ water holding capacity
- ✔ bulk density
- ✔ porosity
- ✔ moisture content
- ✔ organic matter content
- ✔ particle size analysis
- ✔ trace element concentrations
- ✔ stability/maturity measures

Soilless media mixes and soils amended with compost can also be analyzed for most of the above parameters, whereas plants grown in them can be analyzed for plant growth and yield. A summary of suggested values for these parameters based on the intended use of the compost is available in the Composting Council publication Suggested Compost Parameters and Compost Use Guidelines (Composting Council, 1996).

V. STATE AND LOCAL REGULATIONS

Currently there are no federal regulations that govern the production of compost. Its application to land is limited, however, by the concentrations of certain trace elements, as established in EPA rule 40 CFR 503.

Almost all states regulate the production of compost, although they differ widely in their approach. In most cases, some exemptions exist for small-scale and/or farm-based operations. In Virginia, the Department of Environmental Quality (DEQ) regulates the production of compost under two sets of regulations: the Vegetative Waste Management Regulations and the Solid Waste Management Regulations. The sale of finished compost and materials containing compost is regulated by the Virginia Department of Agriculture and Consumer Services (VDACS) under the Virginia Fertilizer Law, whether they are sold as fertilizers or soil amendments. However, unblended composts are exempt from the Virginia Fertilizer Law if no fertility claims are made. In other states, both production and distribution of compost are often regulated by a single agency.

Farmers are exempt from compost production regulations in Virginia and some other southern states if they compost only yard and agricultural wastes and utilize the finished compost only on their land. Various permitting exemptions are also available in several states, including Virginia, for some on-farm composting operations that function as commercial facilities. However, facilities around the south are being increasingly regulated according to a tiered classification based on quantity and/or type of feedstock materials.

North Carolina and Florida are among the southern states that require testing of finished compost for a variety of characteristics including heavy metals and pathogens. An indicator of stability is also commonly required for the end product. No specific performance standards exist for finished compost in Virginia; however, compost is defined in the waste management regulations as "a stabilized organic product produced by a controlled aerobic decomposition process in such a manner that the product can be handled, stored, or applied to the land without adversely affecting public health or the environment." Compost is not defined by the Virginia Fertilizer Law.

Regional and local regulations are found in zoning ordinances and planning district long-range documents. These can promote or hinder the establishment of a farm-based composting program for municipal yard wastes and must be addressed early in the process. A central consideration among zoning and planning officials is whether composting is to be considered an agricultural or industrial enterprise.

VI. THREE VIRGINIA CASE STUDIES

A. CENTRAL VIRGINIA LEAF DISTRIBUTION PROGRAM

Background. The leaf distribution program in central Virginia was created by the Central Virginia Waste Management Authority (CVWMA) in November 1992 to eliminate existing leaf dumping areas and to offer an economic alternative to delivering leaves to landfills or municipal composting sites. Leaf stockpiles in some localities had become an eyesore and/or were occupying properties with rapidly rising real estate values. High transport costs in delivering collected leaves to disposal sites were a concern for other localities.

CVWMA contracts with thirteen jurisdictions in central Virginia, including the City of Richmond and surrounding counties, cities and towns. The member jurisdictions conduct their own collection and hauling, and hold "put or pay" agreements with CVWMA. (Under this arrangement, jurisdictions are required to pay a contract fee based on estimated disposal tons even if the actual total is below that amount.) CVWMA manages three regional leaf composting sites. Jurisdictions contract with farmers to accept the leaves for direct soil incorporation and/or composting instead of transporting collected and stockpiled leaves to CVWMA sites. Contracting with farmers to receive municipal leaves becomes attractive when savings in transport costs exceed the tipping fee paid to farmers.

Program Operation. Leaves are delivered both loose and in kraft paper bags in dump or packer trucks owned by the jurisdictions. The jurisdictions are required to provide staff to remove leaves from the bags within 72 hours of delivery. Farmers invoice CVWMA monthly, based on delivery tickets, and are paid a tipping fee of $7.50/ton, with adjustments each year based on the Consumer Price Index. No greater than 1200 tons is delivered to any one farm in a year unless approved by the Virginia Department of Environmental Quality (DEQ), no quantities are guaranteed, and each truck is considered by all parties to be full. Farmers must provide:

a) an area where the leaves are to be deposited;

b) a suitable access road; and

c) a drop box for delivery tickets on which the truck driver records each load, and

d) all necessary equipment after leaf delivery.

Leaves are allowed to accumulate on the farms until the end of the season. Farmers form windrows, often using rubber-tired front end loaders, and turn the windrows a few times during the year. Within 18 months after receipt of the leaves, farmers use manure spreaders to apply composted leaves to their fields for production of vegetable crops, small grains, pasture and hay. [Note: Virginia DEQ regulations require that, for individuals to be exempt from solid waste regulations, 75% (volume basis) of stockpiled leaves must be utilized within 18 months of receipt.]

Impact of the Program. The number of farmers enrolled in the program has ranged from one to thirteen, although not all receive leaves in any one year. Ten farmers were enrolled in the program in FY 1996 and 1997. Several of the original farmers still participate in the program, one of whom has reported a 70 % increase in soil organic matter concentration and a savings in fertilizer and lime applications of $70/acre.

In FY 1995, over 3,280 tons of leaves were delivered to participating farms. In FY 1996, with the City of Richmond withdrawing in order to compost its own leaves, a total of 1,359 tons of leaves were delivered to three farms. In FY 1997, four jurisdictions were still utilizing the leaf distribution program. Reported savings to the jurisdictions ranged from approximately $1 to $5/ton.

B. CITY-TO-FARM LEAF DISTRIBUTION AND COMPOSTING PROJECT - ALBEMARLE COUNTY

Introduction. A joint project between Virginia Cooperative Extension (VCE) and the Rivanna Solid Waste Authority (RSWA) was conducted between August 1995 and December 1996 to develop and document a program for distribution and composting of leaves on farms in central Virginia. Initiated by RSWA, and carried out in part with grant funds secured from the USDA Sustainable Agriculture Research and Education Program, this program and its success was based upon the creation of linking farms to a municipal yard waste authority.

Farmer Enrollment. The RSWA and local Extension personnel solicited farmer participation through advertisements and personal contacts. Two informational meetings were held to present the details of the program. Six farms participated in the program, including a landscape/nursery operation, organic vegetable farms, and beef cattle operations.

Farmer Education. Some of the participants had previous composting experience; nevertheless, farmer education was an important part of the project. The following educational techniques were utilized at various stages throughout the program to create awareness among farmer-composters of what compost is, how compost is made, what the economic advantages and disadvantages are, and how compost can be used.

1.) Project coordinators organized a field trip for the farmer participants, Extension agents and representatives of the RSWA to visit an on-farm composting operation in northern Virginia. The farm manager utilizes a self-propelled windrow turner to co-compost a wide variety of organic materials, including municipal leaves. The finished compost is applied on the certified organic vegetable farm. Process control, end-product characteristics, and compost utilization in crop production were demonstrated and discussed.

2.) A 30-page handbook was developed and provided to each of the farmer participants as a resource guide on composting principles, processing, troubleshooting, end-product quality guidelines, and recommended application rates. Tables and charts for recording equipment usage, labor expenditures, and windrow temperatures were included. The notebook was reviewed with each participant during a farm visit prior to the start of her/his composting. This notebook was supplemented with information from other composting publications on an as-needed basis.

3.) The Farm Management Specialist provided individual training to farmer-composters. The farmers learned to utilize spreadsheets for fixed and operating cost allocation in order to enable an accurate assessment of the economics of the composting operations.

4.) Two on-farm field and greenhouse studies were conducted to compare effects of compost and commercial fertilizer on soil or potting media physical and chemical characteristics and on plant growth and yield. Sweet corn was grown at one location and rooted cuttings of two potted perennials were utilized at the other. The research process has provided a basis for further independent investigation on the part of participants.

Project Implementation. A plan to deliver leaves collected in the fall and winter of 1995 and 1996 to area farms was implemented. Five farms each received between 180 and 250 cubic yards of bulk leaves in mid-March of 1996. The sixth received approximately 160 tons (~1610 cubic yards) of bagged leaves during December 1995. Leaves were debagged by municipal workers at the farm. The total volume of leaves delivered to all six farms was approximately 2600 cubic yards.

Compost Production. Each farmer set up a system for windrow construction and turning/mixing that worked best for her/his particular operation in terms of the availability of raw materials, equipment and labor. All but one of the operations co-composted the leaves with chicken or turkey litter from farms in nearby counties. Spent horse bedding or cattle manure collected on-farm supplemented the mix at two farms. Feedstock proportions were determined after estimating C:N ratios and bulk densities of waste materials from previous analyses and from published figures. Composting began within no more than a few days after receipt of materials. Laboratory analysis of poultry litter and horse bedding was performed to permit subsequent assessment of end-quality as a function of mixtures.

Initial pile construction was performed with a tractor and bucket and, in some cases, with a manure spreader. Four of the participating farmers utilized a RSWA tractor-pulled windrow turner (provided at no charge) to turn their compost at least three times. Any additional turning and mixing was conducted with a tractor and attached bucket or fork and was based on availability of labor and on temperature and moisture conditions. Project personnel made regular farm and phone visits to provide guidance to the farmers and nursery operators for compost processing.

Compost Application. Finished compost was used in organic vegetable production and landscaping projects, sold in bags from the nursery retail operation, and sold in bulk from at least one farm. Two on-farm field and greenhouse studies were conducted to compare the effects of compost with commercial fertilizer or potting soil on media physical and chemical properties and plant growth. One of the participating farms is purchasing compost from another for use in greenhouse nursery production. Economic Costs for the Participating Farms and of the Project. Each participating farm recorded labor and management time, plus quantities and cash costs of materials and equipment used in compost production. For machinery overhead costs, expense estimates were made using published machinery cost figures. No estimates were made of site preparation costs, or of the cost of the windrower, which was available to the farms at no cost.

Table 1 displays compost production costs per finished yard. As can be seen, costs vary widely from about $6 to $20 per finished yard. However, Farms 3 and 4 had unusual production situations that affected their costs. Farm 3 did not complete adequate turning of the composting material, and hence did not have a completely composted final product by project end. Farm 4 received far more leaves and produced more compost than any of the other farms. However, production inefficiencies due to the unexpected volume of leaves and site conditions resulted in more than double the labor and equipment costs of other farms. The average production cost across the four farms was $12.36 per finished yard. Given the extreme costs of Farms 3 and 4, typical farm-level production costs of compost production probably lie closer to the $10-12/yard range. However, these costs do not consider site preparation investment, or product loading for farm sale, or investment and operating costs of a windrower. The annualized investment cost of the windrower would be expected to add an additional $0.75-$1.75/yard to the cost of the finished product, depending upon the scale of production.

Table 1. Farm costs per yard of finished compost.

Cost Category	Farm 1	Farm 2	Farm 3	Farm 4
Materials	$6.60	$4.41	$4.00	$4.62
Labor & equipment	$4.27	$7.57	$1.80	$15.74
Other	—	$0.35	—	$0.09
Total	$10.87	$12.33	$5.80	$20.45

Project costs beyond normal operation to the municipality and the RSWA are reported in Table 2. and include additional delivery costs to the farms, windrower transport, and program administration. Debagging costs would be incurred in any case on project farms or at traditional disposal sites, so debagging costs are not considered here. In most cases, delivery time and hence cost was greater to project farms than to traditional disposal sites, and this additional cost was estimated. Equipment and labor costs of transporting a publicly-owned windrower between case

farms and additional charges for administration were also estimated. Total costs beyond those for usual collection, delivery, and disposal were approximately $4000, or $1.50 per yard delivered during the project.

Table 2. Additional project costs to waste management programs.

Item	Cost
Delivery (labor & equipment)	$1,970
Windrower transport	$313
Administration	$1,680
Total	$3,963

Municipalities may consider purchasing a windrower to promote composting program participation by farmers. The unit used in this project cost $13,000, and its overhead and operating costs, plus those of a suitable tractor and operator, are approximately $0.75-1.75 per yard of finished compost, depending upon the amount produced. Hourly overhead and operating costs of between $40 and $80 per hour of operation are expected over the likely range of compost output.

Outreach. Project outreach activities were as follows:

a.) The project team presented an On-Farm Composting Field Day in June 1996 as an In-Service Training for VCE and as an educational event for other interested individuals. It included demonstrations at two farms, including one of those in the program, using both turned windrows and static pile aeration composting systems . A 13 page handout, which included a composting process overview and list of resources, was produced for participants. The 31 attendees included VCE agents, Soil & Water Conservation personnel, Virginia Department of Conservation & Recreation Nutrient Management Specialists, farmers, and nursery operators from many parts of Virginia.

b.) The project team conducted an educational forum, The Successful Municipal Yard Waste Composting Program, on August 1, 1996 at the annual conference of the Virginia Recycling Association. The program, which drew approximately 30 participants, addressed composting principles, technologies, regulations, practices, and successful public/private partnerships. Project team members and participating farmers were among the presenters. The audience included public and private waste managers, VCE personnel, private composters and marketers, educators and planners.

c.) Presentations about the project and the benefits of composting were offered in 1996 at the annual Composting in the Southeast and the Virginia Sustainable Agriculture Conferences. Approximately 25 people attended each of these presentations. A poster session, reaching more than 200 individuals, was presented in November 1996, at the annual conference of Composting Council, the nationwide advocacy organization for composting and compost utilization.

d.) Various articles and publications have been produced for waste managers, farmers and educators, including a farmers composting guide and this handbook.

e.) An educational seminar was provided to assist extension personnel, waste managers and farmers in the development of a leaf distribution and composting project in another Virginia county.

Results and Discussion. Farmer feedback was positive, and all participants continue to compost and utilize or sell the finished material. Those utilizing the windrow turner found the composting process to be more rapid and the finished product more desirable than without it. The City of Charlottesville found direct leaf delivery to a farm to be a better option than stockpiling at the present location. As a result, one of the project farmers has entered into a 5-year contract with the City to receive at least 1,000 tons of leaves annually. The agreement includes leaf debagging at the composting site by city employees.

Project coordinators also worked closely with one of the senior environmental engineers in the Virginia Department of Environmental Quality (DEQ) to clarify the regulations concerning yard waste composting with agricultural manures on farms. The Agency's interpretation confirmed that manures, whether they be generated on-farm or imported, are an allowed material.

Despite the general positive response, some problems did occur in the leaf delivery and composting operations. The major impediments to a more successful program were:

a.) Leaf delivery logistics and timing problems resulted in later receipt of leaves than desired by farmers for efficient composting initiation. Delivery truck breakdown and weather conditions also delayed

composting start-up dates. Five of the six participants did not receive leaves until March, when spring growing season activities were already underway.

b.) Inadequate space and inappropriate slopes hindered optimal compost pad siting in two cases. Adequate space for 300+ cubic yards of material is not necessarily hard to find on a particular farm; but equipment access and maneuverability, and surface slope are important additional considerations. A much greater volume of leaves than initially planned was delivered to the farmer participating in the direct-haul arrangement, which resulted in logistical difficulties for equipment use.

c.) Utilizing a manure spreader for initial windrow construction proved to be effective only when small volumes of alternating individual feedstocks are added continuously or when feedstocks are layered in the spreader before operation; otherwise, the resulting windrows include unmixed sections of single feedstocks. Follow-up mixing with a manure spreader is very effective, but is more time-consuming than utilizing a tractor with bucket, a front end loader, or a back-hoe.

d.) Variations in process performance occurred with the mix of 6 parts leaves to 1 part litter (vol/vol). In some cases, windrows continued to heat for several weeks to temperatures greater than 140°F following daily or every other day turnings. Temperatures rarely exceeded 122°F at other sites. This result illustrates the impact of both feedstock characteristics and composting conditions. Litter sources varied in C:N ratio, moisture content and bulk density. Litter was stockpiled without cover for up to a month prior to windrow construction at some locations, and the age and condition of delivered leaves varied. Excess water supply from snow and rainfall resulted in longer composting times than expected for most farmers because of lack of equipment or labor and time to adequately aerate the windrows. However, no objectional odors were reported by participants or their neighbors.

A critical production-related lesson gained from this program was that generators, haulers and farmers all need to be aware of the importance of feedstock consistency for efficient processing and production of a high quality end-product. Farmers also need to be aware of the impacts of climate and age on feedstock performance and of the constraints imposed by equipment, land, labor, and time in order to maximize quality and minimize processing problems.

C. REGIONAL YARD WASTE COMPOSTING PARTNERSHIP EFFORT - ROANOKE VALLEY

Program Initiation. The Roanoke Valley Yard Waste Composting Partnership was initiated by the Roanoke County Solid Waste Coordinator after he learned of the CVWMA and RSWA programs at the 1996 Virginia Recycling Association Composting Forum. Subsequently, a program was initiated in the autumn of 1996 for the Roanoke Valley, which included the City of Roanoke, Roanoke County, the City of Salem, and the Town of Vinton. With the exception of the City of Salem, all of these local governments are members of the Roanoke Valley Resource Authority, a central waste management body. Both the Roanoke County and City of Roanoke Cooperative Extension agents assisted in the effort.

An educational program was developed in planning meetings and delivered by VCE to 12 farmers and waste managers. The program topics included composting principles and feedstocks, compost uses and benefits, regulations for farm composting, example partnership programs, and on-farm composting economics. A poultry waste hauler attending the meeting committed to pursue a pilot yard waste composting project in cooperation with Roanoke County and VCE in anticipation of a regional program.

Pilot Project. The composting site was in Roanoke County, on property owned by a commercial chicken pullet raising facility. The composting surface was the concrete slab floor of one of the original pullet rearing houses. Thirty tons of leaves were delivered to the site in December of 1996. VT/VCE secured the use of a tractor-pulled windrow turner owned by the New River Resource Authority in Radford, Virginia. Chicken manure was imported for co-composting from the pullet facility. Composting began in late March and was complete by mid-June. Periodic visits were made by VCE personnel to assess progress and provide technical assistance. The finished compost was analyzed and determined to be a high quality material. The composter concluded that full-scale commercial composting was desirable but economically feasible only if the majority of the leaves collected within the

several jurisdictions would be available to him at no cost. He was willing to haul them from one or possibly several drop-off sites to his composting facility.

Outreach. Invitations were extended on several occasions to citizens, city and county administrators, planning and zoning officials, community college classes, and others to visit and see the process in operation. Most of these site discussions/demonstrations were initiated by the farmer composter in conjunction with VCE agents and specialists, and were attended by groups ranging from two to fifteen individuals.

Program Development. Following a letter of invitation to the solid waste managers and other public works officials in each jurisdiction, an initial exploratory meeting for a regional program was held in February 1997. VCE provided a short presentation on composting and Roanoke County proposed the regional program in which the pilot project composter would haul and compost collected yard waste from all the jurisdictions. It was learned that each locality/ jurisdiction had a different method for handling yard wastes, including: grinding leaves for citizen pick up processing and offering mixed chipped yard waste to citizens landfill disposal of leaves, grinding of brush for citizen pick up grinding leaves and chipping woody waste for sale

A follow-up meeting was held to explore the real potential for a regional program. The objectives of this second meeting were to:

a) share yard waste tonnage and costs for collection and handling;

b) discuss the potential cost savings, if any, to each locality;

c) identify other benefits of a regional program;

d) explore options and estimate costs for a drop-off / hauling agreement(s) between the jurisdictions and the composter;

e) determine the detrimental effects, if any, on the regional waste authority; and

f) identify potential problems, such as collection/ drop-off/hauling logistics and composter performance.

Attendees reported little of the anticipated yard waste management cost information. However, an agreement to use the existing waste transfer station as a central site for leaf drop-off with a lower tipping fee than that currently charged for yard waste was secured from the Roanoke Valley Resource Authority director. The composter expressed a willingness to provide some amount of finished compost to one or more of the jurisdictions for use on grounds maintenance projects. An argument in favor of program participation was conveyed by several waste management authorities because Virginia Department of Environmental Quality restrictions on leaf volume stockpiling was being exceeded.

Results. Despite the success of the pilot project and persistent efforts for implementation over the next several months, the Roanoke Valley Regional Yard Waste Partnership did not materialize. No commitment was made by most of the jurisdictions and Roanoke County planning and zoning officials authorized only a limited operation. Roanoke County continued to deliver the majority of its collected leaves to the site, paying the composter a $10/ton tipping fee. As of September 1997, Roanoke City had independently initiated removal of its leaf stockpile by distributing material to several area farmers. The other jurisdictions were continuing to employ their same yard waste management practices but anticipated the need to make some changes in coming months or the next few years.

Barriers. Economics was the major barrier to realization of the program. Clear current savings would accrue from program participation for only one of the jurisdictions. Other jurisdictions found it difficult to determine pro-rated machine use and service costs for yard waste processing. Waste managers are not likely to compile these figures if an existing practice seems adequate. This is especially true if income accrues from sales of processed yard wastes.

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APPENDIX PROGRAM COST ESTIMATE WORK SHEETS

Worksheet 1

Collection and Delivery Costs of CURRENT Stockpiling/Disposal System
(NOTE: Operating expenses include maintenance & repairs, fuel & lubricants, and labor)

A. Cash Operating Expense for Equipment

1. Compactor trucks:
(_____units) x (_____)$/hr x (_____)hrs = $_____

2. Vacuum leaf collectors:
(_____units) x (_____)$/hr x (_____)hrs = $_____

3. Catch basin cleaners:
(_____units) x (_____)$/hr x (_____)hrs = $_____

4. Front end loaders:
(_____units) x (_____)$/hr x (_____)hrs = $_____

5. Dump trucks:
(_____units) x (_____)$/hr x (_____)hrs = $_____

6. Other equipment:
(_____units) x (_____)$/hr x (_____)hrs = $_____

Total of Equipment Cash Expenses = $_____

B. Cash Expense for Labor (including cost of fringe benefits)

1. Truck drivers:
(_____persons) x (_____)$/hr x (_____)hrs = $_____

2. Equipment operators:
(_____units) x (_____)$/hr x (_____)hrs = $_____

3. Other workers (i.e. debaggers)
(_____units) x (_____)$/hr x (_____)hrs = $_____

Total of Labor Expenses = $_____

C. Other Stockpiling/Disposal Cash Expenses

1. Tipping fees = $_____

2. Overtime labor = $_____

3. Other _____ = $_____

D. Total CURRENT Stockpiling/Disposal Cash Expenses (A+B+C) = $_____

Worksheet 2

Collection and Delivery Costs of PROPOSED Stockpiling/Disposal System (NOTE: Operating expenses include maintenance & repairs, fuel & lubricants, and labor)

A. Cash Operating Expense for Equipment

1. Compactor trucks:
(_____units) x (_____)$/hr x (_____)hrs = $_____

2. Vacuum leaf collectors:
(_____units) x (_____)$/hr x (_____)hrs = $_____

3. Catch basin cleaners:
(_____units) x (_____)$/hr x (_____)hrs = $_____

4. Front end loaders:
(_____units) x (_____)$/hr x (_____)hrs = $_____

5. Dump trucks:
(_____units) x (_____)$/hr x (_____)hrs = $_____

6. Other equipment:
(_____units) x (_____)$/hr x (_____)hrs = $_____

Total of Equipment Cash Expenses = $_____

B. Cash Expense for Labor (including cost of fringe benefits)

1. Truck drivers:
(_____persons) x (_____)$/hr x (_____)hrs = $_____

2. Equipment operators:
(_____units) x (_____)$/hr x (_____)hrs = $_____

3. Other workers (i.e. debaggers)
(_____units) x (_____)$/hr x (_____)hrs = $_____

Total of Labor Expenses = $_____

C. Other Stockpiling/Disposal Cash Expenses

1. Tipping fees = $_____

2. Overtime labor = $_____

3. Other _____ = $_____

D. Total PROPOSED Stockpiling/Disposal Cash Expenses (A+B+C) = $_____

Worksheet 3

Cost Difference Between Current and Proposed System

Total CURRENT Stockpiling/Disposal Cash Expenses (Worksheet 1) = $_____

Total PROPOSED Stockpiling/Disposal Cash Expenses (Worksheet 2) = $_____

Cost Advantage/Disadvantage of Proposed System = $_____

Worksheet 4

Break-even Farmer Tipping Fees Under Proposed System

Total CURRENT Stockpiling/Disposal Cash Expenses (Worksheet 1) = $_____

Total PROPOSED Stockpiling/Disposal Cash Expenses MINUS proposed tipping fees (Worksheet 2) = $_____

Break-even Tipping Fees of Proposed System = $_____

DISCLAIMER

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