
TECHNICAL PAPER #7

UNDERSTANDING COMPOSTING

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PREFACE

This paper is one of a series published by Volunteers in Technical Assistance to provide an introduction to specific state-of-the-art technologies of interest to people in developing countries. The papers are intended to be used as guidelines to help people choose technologies that are suitable to their situations. They are not intended to provide construction or implementation details. People are urged to contact VITA or a similar organization for further information and technical assistance if they find that a particular technology seems to meet their needs.

The papers in the series were written, reviewed, and illustrated almost entirely by VITA Volunteer technical experts on a purely voluntary basis. Some 500 volunteers were involved in the production of the first 100 titles issued, contributing approximately 5,000 hours of their time. VITA staff included Leslie Gottschalk and Maria Giannuzzi as editors, Julie Berman handling typesetting and layout, and Margaret Crouch as project manager.

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VITA is a private, nonprofit organization that supports people working on technical problems in developing countries. VITA offers information and assistance aimed at helping individuals and groups to select and implement technologies appropriate to their situations. VITA maintains an international Inquiry Service, a specialized documentation center, and a computerized roster of volunteer technical consultants; manages long-term field projects; and publishes a variety of technical manuals and papers.

UNDERSTANDING COMPOSTING

By VITA Volunteers J. Walter Fitts and Jerry B. Fitts

I. INTRODUCTION

Composting is the process of bringing together plant or animal wastes to hasten their decomposition. The result of this process is a nutrient-rich organic fertilzier called compost or humus. Farmers have practiced composting for thousands of years. They

knew that the use of plant and animal wastes would return nutrients to their soil and enrich their farmlands. This in turn promoted the growth of their crops. In sum, they took advantage of all the plant and animal wastes that were so abundant and made rich compost from them, instead of burning them or throwing them away.

Composting, however, is not to be regarded as a basis of permanent soil fertility. This concept is inapplicable because the application of decomposed waste will not neutralize excessive soil acidity (i.e., increase soil pH) nor will it supply corrective applications of nutrients such as phosphorus on a phosphorus deficient soil.

The most attractive and feasible concept is the use of composting in a gardern plot. The advantage is: the ease with which the plant residues from the garden may be supplemented with those grown elsewhere.

Adding compost to soils high in clay loosens and improves compacted soil. This increases both the infiltration and water holding capacity of the soil. In sandy soils, the addition of composts increases the organic matter content of the soil, which in turn increases the soil's ability to store water. By increasing the infiltration of water into the soil, compost can also help to reduce soil erosion. Compost contributes nutrients from organic materials that would otherwise have been wasted. This more favorable soil environment can increase the depth and density of root growth. Composting also favors plant growth by destroying many harmful weed seeds, insect eggs, and disease organisms during a stage where a lot of heat is generated. Due to the positive influence on chemical and physical properties of a soil, compost can increase the productivity of your land.

Fine finished compost serves as an excellent soil basis to transplant seedlings into. When mixed into the seed bed, compost provides nutrients and an extra source of moisture for the germinating seeds. Compost can be applied throughout the growing season to crops as a sidedressing mixed in a depth of an inch or so just before a rain. Mulching with compost nourishes the crop while controlling weeds. In locations where plots of land are not available, compost can serve as the soil base of potting soil for indoor or container gardening. Composting is also an excellent way to utilize fast growing plants such as water hyacinths, which otherwise would create disposal problems.

II. COMPOSTING PRINCIPLES

Decomposition is part of nature's life cycle. Grasses, trees, weeds, shrubs, and other succulent plants obtain carbon, hydrogen, and oxygen from air and water and the dissolved nutrient elements nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, boron, copper, iron, manganese, zinc, and molybdenum from the soil. Then, through the green chlorophyll of their leaves and with energy from the sun, they manufacture food products that nourish other forms of life, including human beings.

At the conclusion of the growing season, leaves and other plant parts wither, die, and become plant residue. However, the plant residue (or animal residue) does not accumulate for long because it is soon attacked by lower forms of plant and animal life. The process of higher plant growth cannot go on indefinitely unless nutrients such as nitrogen, phosphorus, potassium, sulfur, and other elements are returned to the soil. Plant or animal wastes contain compounds that must be broken down (decomposed) so the nutrient elements contained in the waste can replenish the soil and be reused for crop growth.

The replenishing process is carried out mostly by microorganisms, including fungi, bacteria, algae, protozoa, nematodes, and worms. Fungi and bacteria, of which there are several thousand species, are responsible for most of the decomposing process. Some species grow and decompose waste material under a fairly wide range of environmental conditions, whereas others can perform only under very specific conditions. As long as the environmental conditions are favorable, microorganisms will quickly multiply to decompose the waste material, no matter how much waste material is available.

Good composting depends on a number of factors that influence the activity of the microorganisms that cause decomposition. These include: (1) the type of raw waste material to be decomposed; (2) nutrient availability, especially nitrogen; (3) moisture; (4) temperature; and (5) acidity (pH). Other factors to consider in maintaining a composting pile are: nutrient losses during composting, aeration, pests and diseases that may be transmitted, the ratio of carbon to nitrogen, the presence of toxic substances in the waste, etc. All of these factors are discussed in more detail below.

FACTORS INFLUENCING DECOMPOSITION

Type of Raw Waste Material

Almost any plant or animal waste will decompose if preservative measures have not been taken. And some wastes are more resistant to decay than others and are not considered good compost material. Food scraps, including meat scraps, can be used with plant wastes. For rapid decomposition to form a good compost, the waste must be high in carbohydrate, low in lignin compounds, and have a nitrogen content about 1.5 percent or more.

Choose materials according to what is available to you. Here's a list of good things to include (not in order of priority):

* rice husks
* coconut trash
* sugarcane waste
* leaves
* water hyacinth
* corn stalks and husks
* bean plants
* kitchen wastes
* spoiled food
* sawdust or wood shavings
* banana skins and leaves

* crushed animal bones
* seaweed
* garden trash (e.g., weeds, stalks, leaves, pads)
* manure from cattle, chicken, pigs, etc.

Many materials for composting can be obtained free from manufacturers such as:

* dried blood, bones, and hair from animal slaughter houses;
* hulls from graineries (rice, corn, cocoa, beans, peanuts)
* coal ashes
* fish scraps from fisheries
* hair from barber shops
* molasses residue from sugar factories
* sawdust and woodchips from sawmills
* leather dust

Items that should not be composted include:

* plastic * glass bottles
* tin cans * wax coated cardboard
* stones * newspaper with colored ink
* human waste * waste from domestic cats and dogs

You should never use human waste in a compost which is to be applied to an area where food crops are to be raised for either humans or animals which will be used for meat. Depending on a person's diet, living location, and health, the human waste can contain metal and chemical compounds which could be hazardous. By composting these compounds can accumulate to high levels within soils. Some plants selectively take up thse compounds. When eaten by humans they can pose a health risk. Thus, it is best not to compost human waste unless a complete chemical analysis can be performed to assure its safety.

Remember, animal waste products such as meat and fish scraps are good too, but may attract hungry dogs, flies, and other insect pests to your pile. One word of caution: manure piles are notorious for attracting flies and other insect pests and the same can happen in compost piles. For steps that can be taken to prevent this from happening, see "Pests, Toxins, and Other Undesirables," page 10.

To speed up the decomposition process, you will want to break up, chop, or grind large chunks (e.g., corn stalks, banana leaves) of raw waste material into small, degradable pieces. Remember, the finer the waste is shredded, ground, or pulped, the easier and faster the decomposition will be.

Nutrient Availability and the Carbon-to-Nitrogen Ratio

Be sure the plant or animal waste to be decomposed contains a sufficient amount of nitrogen. Waste that is deficient particularly in nitrogen, or in other elements such as phosphorus, potassium, calcium, magnesium, sulfur, boron, copper, iron, manganese, zinc, and molybdenum, will slow the growth of bacteria, making decomposition difficult.

Generally, plant wastes should contain about 1.5 percent or more nitrogen for bacteria to function properly during the decomposition process. For wastes high in carbohydrate and low in protein, you may need to apply about 10 kg of nitrogen (25 kg urea or 40 kg ammonium sulfate) per ton of waste.

Carbon-to-Nitrogen Ratio. Generally, the ideal carbon-to-nitrogen ratio of a good compost pile is about 30:1. If the ratio is either much higher or much lower than 30:1, the decomposition process might slow down. Table 1 shows the carbon-to-nitrogen ratios for a variety of raw waste materials. Of the material listed in that table, those whose carbon-to-nitrogen ratios fall in the mid range can be combined or used individually for composting without upsetting the ratio. However, those materials whose carbon-to-nitrogen ratios fall to either extreme of the mid range will cause the ratio to be either too high or too low. So, if you use a material that has a low carbon-to-nitrogen ratio, you will also need to use a material whose carbon-to-nitrogen ratio falls in the high range, enabling the two materials to balance each other out.

Table 1. Carbon-to-Nitrogen Ratio and Nitrogen Content of Compost Materials

Percentage of Percentage of
Raw Waste Nitrogen Carbon-to-Nitrogen Moisture

Material (Dry Basis) Ratio (Fresh Basis)

Fish scraps 6.5-10 4:1 80

Poultry manure 6.3 4:1 75

Meat scraps 5.1 6:1 65

Fresh grass
clippings 4.0 12:1 95

Sun-dried grass
clippings 2.4 19:1 40

Raw garbage 2.15 25:1 90

Mixed fresh
garden debris 2.0 20:1 80

Cow manure 1.7 27:1 80

Seaweed 1.9 19:1 90

Fresh leaves 1.5 30:1 80

Oat straw 1.05 48:1 25

Dry leaves 1.0 45:1 40

Raw sawdust 0.25 208:1 5

Determining the Carbon-to-Nitrogen Ratio of Your Compost. List the various ingredients in your compost and the approximate weight for each. Using the data from Table 2, list for each ingredient the fresh weight, the percentage of moisture, the percentage of nitrogen, and the carbon-to-nitrogen ratio. If the specific material you are using does not appear on the table, estimate the characteristics by comparing it to similar material.

Table 2. Determining the Carbon-to-Nitrogen
Ratio of Your Compost

Fresh Percentage of Carbon-to-
Characteristic Weight Moisture Nitrogen Nitrogen
Ingredient (Pounds) (Percent) (Dry Basis) Ratio

Chicken manure 50 50 6.00 4:1

Sawdust 50 5 0.11 511:1

Food garbage 50 80 2.15 25:1

Dry leaves 75 25 1.00 45:1

Grass clippings 50 95 4.00 12:1

Total 275

Determine from the assembled data the following quantities for each ingredient:

*** the pounds dry weight by subtracting from the fresh weight the percentage of moisture;**

*** the pounds nitrogen by multiplying the dry weight by the percentage of nitrogen contained on a dry-weight basis; and**

*** the pounds of carbon by multiplying the pounds of nitrogen by the carbon-to-nitrogen ratio.**

Compute for the total compost the cumulative moisture content by dividing the total dry weight by the total fresh weight.

Example: 144.5
----- = 53 percent
275.0

Compute for the total compost the cumulative carbon-to-nitrogen ratio by dividing the total pounds of carbon by the total pounds of nitrogen.

Example: 62.80
----- = 27 percent
2.33

Balancing the Carbon-to-Nitrogen Ratio. Spreading a thin layer of well-rotted manure within layers of fresh plant waste provides a good source of nitrogen. Table 1 shows the percentage of nitrogen and phosphate for several types of animal manure.

Table 3. Average Nutrient Content of Animal Manure

Type of Animal	Amount of Nitrogen (Percent)	Amount of Phosphate (Percent)
Rabbit	2.4	1.5
Chicken	1.1	0.8
Sheep	0.7	0.3
Horse	0.7	0.3
Duck	0.6	1.4
Cow	0.6	0.2
Pig	0.5	0.3

Any mixed fertilizer containing nitrogen will be helpful if applied at the rate of about 10 kg per ton of waste. The other

elements, including phosphorus and potassium, which might be in the mixed fertilizers, will promote decomposition also, especially if the waste being decomposed is low in these elements.

Moisture

To increase the rate of decomposition, a compost pile should always be moist but never too wet. Bacteria will grow under a wide range of moisture conditions--from almost dry to saturation. However, the best moisture for aerobic decomposition will be less than saturation but about that of green plants. In soils, it will be slightly above the field capacity or the amount of water a soil retains against gravity. There will be a marked reduction in the number of bacteria and fungus with drying and a great reduction in the rate of decomposition. So the residue should be kept moist but not saturated.

In tropical areas it may be necessary to cover the compost pile with removable mats or temporary shelter to keep rains from saturating the pile.

Temperature

Bacteria grow and decompose wastes at a rather wide range of temperatures, but for composts the optimum temperature is around 30[degrees] to 37[degrees] C, especially during the initial stages of the decomposition process. Turning the pile to permit air to get in will cool the mass. The temperature can also be moderated by wetting the compost pile. If the temperature is kept low, say

below 20[degrees]C, the rate of decomposition will slow down.

One note of caution: the process of decomposition generates heat, and if fresh plant wastes are packed tightly in a pile with adequate moisture, the pile may become quite hot. Many barns have burned down because uncured hay stored in them began to decompose and generated enough heat to start a fire. This is known as spontaneous combustion. The appearance of ash spots in the compost indicates that temperatures are too high and steps should be taken to cool the pile.

Acidity (pH)

Like other conditions, acidity greatly influences the type and number of microorganisms required for decomposition. Some different species of microorganisms will grow at various acidity levels--from very acid (pH 1.0) to strongly alkaline (pH 11.0). Plant wastes decompose best in the pH range of 6.0 to 7.5.

You may need to add some finely ground limestone (preferably dolomitic lime) to keep your compost pile from becoming too acid. Usually 25 kg to 50 kg of limestone per ton of waste sprinkled through the pile is enough to do the job.

MAINTAINING THE COMPOST PILE

Nutrient Losses

Some valuable nutrients, particularly nitrogen, can escape during

the decomposition process. For example, one of the end products of decomposition is ammonia, which can convert to a gas and evaporate into the atmosphere, unless you mix fine-soil clay or ground phosphate into your compost pile. In addition, nitrate, ammonia, and potassium ions can seep through the soil, enter the ground water, and dissolve if too much water is applied. And in poorly aerated pockets of the waste undergoing decomposition, valuable nitrogen gas can evaporate into the atmosphere.

You can avoid the loss of nutrients by:

* placing a fence (woven wire) or wooden slats on all four sides to maintain the shape of your pile and to keep animals out;

* not overwatering your pile; and

* mixing fine soil clay or ground phosphate into your pile.

A thin layer of soil on the surface of your pile is good. This absorbs ammonium ions and prevents the loss of nitrogen. The soil layer also discourages insect pests from breeding in your compost pile.

Aeration

If your compost pile (or soil) is well aerated, the microorganisms can obtain oxygen from the atmosphere, and decomposition will be aerobic, with aerobic bacteria and fungi predominating. If your compost pile is compacted, saturated with water, and poorly aerated, the anaerobic bacteria will take over.

Turning the contents of your compost pile at least once a week will: (1) prevent the pile from getting waterlogged; (2) aerate the contents, which promotes rapid decomposition of the raw waste material; (3) mix and spread the nutrients uniformly throughout the pile; and (4) keep the pile from smelling bad.

You can test whether your pile needs to be turned by inserting a stick into the center, and removing the stick after a few minutes. If the stick smells bad, turn the pile. If the pile is dry, add enough water to moisten it.

Clearly, if you turn the contents of your compost pile more frequently, you will produce compost in a shorter period of time, given that all other factors are present. In temperate regions, if you do not stir the pile at all, it will take about four to six months to produce compost. If you turn the pile once or twice every other month, it will take about two to three months to produce compost. If you turn it once every other day (i.e.? four or five times in two weeks), your compost will be ready in about two weeks. In tropical regions these time periods will likely decrease.

Pests, Toxins, and Other Undesirables

A major problem in using composts is the possibility of spreading disease organisms (fungi and virus) and insects. Spores from disease pathogens may carry over in the compost pile and then be spread over a field to a new crop. Though heat produced in the compost pile during decomposition may destroy weed seeds and most insects, the spores of many fungi, including the fungi causing some plant diseases, may not be destroyed. For this reason, tobacco, potato, and tomato crop wastes are not recommended for use in compost piles as they may carry serious plant diseases.

To protect a compost pile against insect pests, spread a thin layer of soil over the top of the pile. This soil layer also prevents the loss of nitrogen.

Do not add any raw waste materials to your compost pile that have been treated with herbicides, insecticides, feed additives, or medications (e.g., antibiotics used in animal feeds or injected into animals). Such materials risk (1) slowing down the decomposition process; (2) retaining nondegradable amounts of toxins in your compost; (3) killing your food crops caused by toxins in your compost.

Correcting Problems During Composting

If your compost pile does not heat up:

* You may not have used enough nitrogenous material. This means you may have used too much sawdust, paper, or straw, all of which have very high carbon-to-nitrogen ratios due to their high cellulose and lignin

content. To correct this problem, simply add more of a good nitrogen source to your compost pile.

* Or you may have added too much water to your compost pile. Too much water suffocates the aerobic organisms (i.e., they need oxygen to function) to the point where the anaerobic organisms (i.e., they work in an oxygen-free environment) take over, producing ammonia and bad smells. To correct this problem, turn your compost pile frequently or layer the raw waste material into a long-term compost pile.

If your compost pile gives off a strong smell of ammonia:

* You may have added too much of a high nitrogen source to your compost pile. To correct this problem, simply add old leaves, straw, or shredded paper in small amounts.

* Or you may have added too much limestone or other element high in calcium carbonate to your compost pile. This is difficult to remedy, but adding acid leaf litter and wet garbage may help. Next time, add the calcium to the soil rather than to the compost pile.

Recognizing Finished and Semi-Finished Compost

The following are signs of finished compost:

* ammonia smell is gone;

* the temperature of the compost pile has cooled down completely;

* the compost is crumbly, dark, and sweet smelling; and

* at least three species of arthropods are present (e.g., the sow and pill bug, ground beetle, and centipede).

Indications of semi-finished compost that can best finish composting in soil are:

* the compost pile smells slightly of ammonia;

* the temperature has started to decline but steam still comes off; and

* possibly one or two species of arthropods are present.

When and How to Apply the Finished Compost

It is best to use the compost when it is still fresh. Remove the compost in sections from top to bottom of the pile rather than from the top only. If time and labor permits screen the compost through a 0.6 cm mesh screen and return the larger materials to the compost pile. To avoid losing the compost to wind or water erosion it is best to incorporate it into the soil, particularly when it is used in large or sloping land areas.

III. DESIGNING THE SYSTEM RIGHT FOR YOU

COMPOSTING METHODS

A wide range of composting methods is available. These extend from simply adding raw waste material to soils and allowing it to decompose under natural conditions, to sophisticated containers with special chemical fertilizers that help raw waste material to rot quickly. Because chemical fertilizers are costly and not always readily available to people in developing countries, we have focused only on those composting methods that do not require commercial fertilizers.

As you familiarize yourself with the various composting methods outlined in this section, keep in mind that you may have to adapt specific methods to local conditions and available resources. You can modify a particular method a little to fit your resources without decreasing its overall effectiveness.

The size of a compost pile depends upon the amount of raw waste material available and how it is to be used. The biggest factor is to have a manageable pile large enough to take care of available waste materials but small enough to be tended easily. If great quantities of material are available, such as from a slaughter house or sugar factory, several smaller piles will probably be more manageable than a single large one.

Composting in Pits or Heaps

Although natural composting (i.e., decomposing raw waste material directly in the soil) retains just as many nutrients as does controlled composting (composting in a pile), the latter method nevertheless offers more:

* raw waste material decomposes much faster in a pile;

* the temperature within a compost pile is much higher than that found in soil;

* controlled composting kills many weed seed and reduces potential pathogens;
* decomposed compost applied to soil loosens hard, compacted soil immediately, allowing the soil to take up oxygen and to absorb water in a much shorter period of time; and

* adding decomposed manure to soil promotes the growth of food crops, whereas adding fresh, undecomposed manure can damage the crops (i.e., the crops burn due to the high amount of nitrogen in fresh manure).

Choose a protected area, well drained and close to a water source. The site should also be conveniently located since it should be checked regularly. In temperate climates it may be best to avoid shaded areas since this will lower the temperature during cool seasons. In tropical or arid regions, shade may be more beneficial in decreasing moisture lost by evaporation.

Chop or crunch under a roller all hard materials such as sugarcane stubbles and dry stalks. Split up and cut all the soft but bigger-sized materials like banana stumps. Dig a pit approximately 1.5m x 1.5m x .5m deep. Heap all the available refuse around the pit. To make the material decompose easily, use a "starter." The starter can be dung or urine. If these are not available, well-decomposed manure, tank silt, or surface scraping from forests can be used. To make a good compost, you also need some ash and dry earth.

As shown in Figure 1, organic materials are layered in categories

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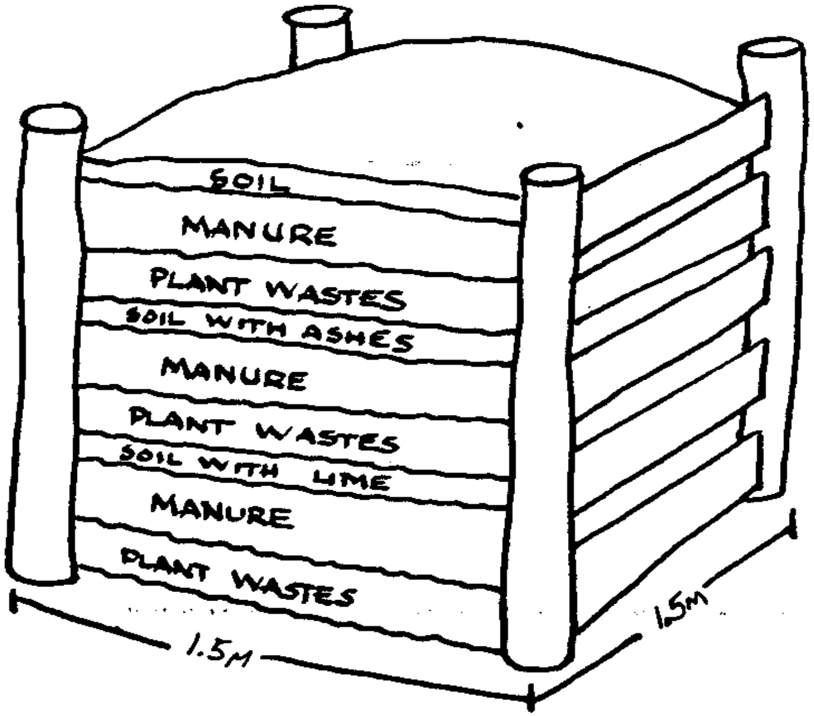

Figure 1. A Compost Pile

in the compost pile and kept moist. To prepare the compost pile, put the refuse in the pit in a layer about a foot high. Sprinkle 16 gallons (four or five buckets) of water and a thick paste made with 60 pounds (two buckets) of dung in 16 gallons of water. Spread half a basket of ash and one basket of the starter on the layer. Put the second layer of trash over this. Five such layers will bring the heap two feet above the ground level. Cover this with a three-inch layer of soil on the top. See to it that you fill the pit completely in a day or two.

Speed Composting

Speed composting requires that all materials either be chopped into small particles (large kitchen scraps, weeds, straw) or already come in small sizes (grass, leaves) and that the slower decaying materials such as wood, twigs, eggshells and bones not be used.

The volume of the compost pile should be no less than one cubic meter to allow the generation and retention of heat. Ingredients must be layered by categories (dry, green and manure) so that the pile builder can estimate the ratio of the different materials. Essential to the speed composting method are:

* **frequent turning,**

* **proper moisture levels, and**

* **sufficient amounts of nitrogen to promote decomposition.**

Here is a simple formula for speed composting:

* **Loosen the soil in the area where the pile is to be built.**

* **Build a bin no smaller than 1m x 1m x 1m.**

* **Layer compost ingredients as follows:**

- Bottom layer--approximately 6 inches of absorbent material (straw or sawdust).
- 4 inches of green garden and kitchen wastes.
- 2 inches of manure, possibly mixed with soil.
- 3 to 6 inches dry roughage (dry grass, leaves, or sawdust).

* Repeat this layering until the bin is full, sprinkling the layers with water as you go.

* Every second or third day, turn the pile with a pitchfork or shovel. Turn the outer layers inward, mixing thoroughly from top to bottom. Turning the pile every day speeds up the decomposition process.

* Keep the pile moist but not waterlogged.

* Compost should be ready to spread over your farmland in about one month.

RESOURCES, MATERIALS, AND EQUIPMENT REQUIRED

The resources, materials, and equipment necessary for composting depend on what composting method you employ. Nevertheless, for basic composting you need:

* plant residues and/or animal wastes;

* something with which to turn the compost material (e.g., a shovel, pitchfork);

* a sufficient supply of water to keep the compost moist;

* a cutting tool, (e.g., a machete) to break up large chunks of raw waste material;

* a fence of woven wire, wooden slats, or bamboo, or a simple pit to maintain the shape of the compost pile;

* a supply of urea or ammonium sulfate in case you use raw waste material that is low in nitrogen;

* a supply of finely ground limestone to maintain the acidity level of the compost pile;

* a supply of clay loam, fine soil clay, or ground phosphate to prevent the compost material from losing valuable nutrients during and after the decomposition process; and

* some woven mats, a thick layer of straw, or a straw root to protect the compost pile when it rains.

ENERGY USE/EFFICIENCY

There are essentially four steps in the controlled composting

process that require energy use: collecting the raw waste material, preparing the compost pile, maintaining the pile, and adding the finished compost to the soil. The quantity of energy used in each of these steps depends primarily on the amount of compost being produced. Compared to natural composting, which is simply adding raw material to the soil and letting it decompose naturally, controlled composting in a pit or heap clearly requires more energy. However, because controlled composting speeds up the decomposition process, it can produce compost in a shorter period of time given the right conditions.

COST/ECONOMICS

The cost of composting depends on the amount of raw material available, and whether people and equipment must be hired to collect and process it and return the compost to the soil. Costs must be balanced against the benefits of increased soil fertility, crop production, etc.

The amount of labor needed depends on the method used, size of compost pile, and availability of materials. For a household compost pile, one person may spend on average between one and three hours a week maintaining a pile. This time commitment will vary each week depending on the stage of decomposition of the pile.

Composting is typically done on a small-scale basis within households or on small farms. However, where there is an abundance of raw materials and potential for marketing exists,

composting has been an economically feasible business.

Depending on the quantity and type of materials used, composting has the potential to be sold as a soil conditioner or as an organic fertilizer. This market tends to increase near urban areas where small-scale gardening requires a source of soil. If raw materials are readily available and labor or low cost equipment are available, composting has the potential to be maintained as a business.

SPECIAL PROBLEMS

Due to the potential health problems there may be laws in more populated urban areas which prohibit the use of certain materials for composting. These restrictions should be explored.

IV. COMPARING ALTERNATIVES

The main disadvantage of composting is that it can be time consuming and the pile must be checked regularly. Beyond this the disadvantages of composting only become apparent when proper care for the compost pile is not followed. Insects and animals can be attracted to the pile if the raw materials are not selected or covered carefully. Disease and weed problems can increase if the compost pile did not heat up sufficiently (to kill them while composting). The pile can be a potential fire hazard if moisture, temperature, and aeration are not watched regularly.

Composting is relatively inexpensive and simple. Thus, if you want to convert waste organic materials to fertilizer, composting would be a good choice.

On the other hand, if large quantities of raw materials are available and you want to produce more than just fertilizer, you might consider biogasification as an alternative. With biogasification, raw waste materials can be digested under specific anaerobic conditions, and returned to the environment in the form of fertilizer and fuel, without degrading the environment. Biogasification requires a considerably larger investment in capital, materials, and labor. For example, the equipment (i.e., a biogas digester, systems, pumps) necessary for biogasification is generally more expensive than the equipment necessary for composting.

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