10. Composting

Composting is *Fundamental #4*. Compost will build up organic matter and create humus for your soil. The finished product of decomposition is called compost. Composting is a controlled process in which we capture a high percentage of nutrients from our crop residue and return it back to the soil in a form that is very nutritious. Composting is as much an art as a science by which we create an environment for the natural processes of nature to work efficiently. Remember, we feed the soil, and the soil will feed the plant! We will discuss the classic aerobic systems that work well for us. Then we will highlight our anaerobic processes and incorporate

them with planting. We also have a very successful Vermiculture operation we will outline for you.

AEROBIC COMPOST

Most aerobic composting methods utilize the heat process from thermophilic bacteria to kill off both pathogens and weed seeds. Carbon-to-nitrogen ratios need to be 30 parts carbon to 1 part nitrogen for best results. The ratio is usually denoted as 30:1 or simply 30, meaning the units of carbon related to one unit of nitrogen. The best compost piles are made in layers. We layer the organic matter. Layering assures that the ratio of ingredients from each class of organic material is balanced. This allows us to see the amounts and proportions that are going into a batch easily. Balanced nutrients are important for high quality production.

Layering assures the proper proportion of carbon and nitrogen for fuel to grow the microbes. The layered pile gets turned 5-7 days after assembly, a total of three times in 3 weeks.

A crude formula by volume would be: 2 sacks of high carbon matter for each sack of high nitrogen ingredient. When we accumulate

approximately 1 meter^3 of crop residue and weeds we have enough volume to mix. Smaller piles will not hold heat and loose moisture. Piles higher than 1 meter will compress, run out of oxygen quickly and putrefy in the center. You can form a *windrow* as long as you want, but it should not be more than 1 meter high and 1 meter wide. We add 2 pails of bokashi, 2 pails of soil and 10 pails of manure. The soil is helpful in forming humus and bringing in mineral nutrients as well as microorganisms. We add moisture with a hose to get the water content higher. We want it moist but not dripping wet. If we use dry straw or manure we add more water than when starting with wet ingredients. We also add fermented rice wash. This brings in the EM family to insure high quality finished compost.

Compost tumblers make it easier to produce small batches of compost. Composting bacteria need air. It is very easy to aerate compost by rotating the drum. Our steel compost tumbler worked well, but the humic acids are hard on the metal and the welds. The effect is to feed the thermophilic bacteria with oxygen so that they continue to work.

We usually turn piles once every 5-7 days for a total of 3 times to add oxygen. You can vent with air tubes, but mixing/turning is required for best results. The outer layer does not compost till it is in the center and goes through the heat cycle to kill the destructive bacteria. All manure should be composted if used on food crops. The thermophiles work to eliminate pathogens, after 3 turnings they are done working, now the pile will cool. That's 15-21 days for our 3 turnings. Then we let the mesophiles bacteria finish it off at lower temperatures and mature for another 1-2 months. These bacteria dominate at temperatures lower than thermophiles.

A plastic drum lasts longer than steel. It works to aerate the compost by rotating organic matter through the tumbling action of the paddles.

There is much debate over how often it should be turned and how long it needs to mature, but we keep it simple. We use Effective Microorganisms (EM1) to inoculate the pile and guide it away from

disease propagation. We use EM in the form of Bokashi. It is high in nitrogen and rich in beneficial bacterial growth.

The forage chopper is an inexpensive alternative for a powered shredding machine. We use ours for chopping corn stalks, sugar cane, weeds, sorghum stalks, etc. The chopped greens make great feed for the goats, hogs and cow. It is ideal for most small scale composting because it increases surface area and gives the microbes more to break down into fertilizer. This one fits onto a metal horse that we use for repairing vehicles. You can make it to stand alone with wooden legs, as long as it is sturdy enough for the constant striking of the mighty bolo (machete).

With the full range of the EM family active in our piles, we find that we can use our compost as fertilizer in 2-3 months. This is the tropics after all; things progress quickly in our Palawan climate. Our microbes set records because there is no fall, winter or spring. The tropical climate also means you can see 3-4 plantings instead of 1-2 in regions where the winters do not permit continual food production.

The microbes keep working; we keep composting. Moreover, we keep planting year round too!

Table 4 - Carbon to Nitrogen [C / N] Ratios

Material	C/N
Chicken Manure	16:1
Hog Manure	19:1
Cow Manure	30:1
Kitchen Waste	20:1
Rice Hull	400:1
Straw	200:1
Saw Dust	300:1

To speed up the composting process, a shredder/chipper is useful. It needs to be able to create surface area efficiently, so that microbes have lots of food. In the tropics it is important to be able to shred coconut and chip branches. Materials become valuable compost in less time when the surface area is increased through shredding, chipping or crushing. Look for good safety features to protect the operators from harm.

ANAEROBIC COMPOSTING

Anaerobic composting is a very efficient process of mixing beneficial microorganisms into materials to create powerful, yet inexpensive fertilizers. This process prevents the heat cycle and preserves energy. It is a more powerful finished product than aerobic compost because material is not decayed but rather fermented (pickled). It finishes decomposing when we mix it into the soil and allow more time for the microbes to do their job. They work very fast compared to classic aerobic style composting and preserve more fertilizer value by eliminating heat and gases.

We make our bokashi with this process. This is one method of anaerobic composting. Bokashi is the Japanese word for fermented plant matter. We mix 1 sack of copra meal to three sacks of low-grade rice bran (D3-gaspang) and three sacks of charcoal. We charcoalize rice hull (D4) in a specialized process ahead of time. These ingredients are mixed dry with shovels on a cement floor.

Bokashi Economy 101 - The foolish American farmer on the right spent 1000 pesos on one sack of complete fertilizer and has no money for seeds. The wise Filipino farmers on the left made a ½ ton of bokashi and have money left over for certified seeds.

Then we pour an EM solution into the mixed grains and waste material. We use 200 ml. of EME and 200 ml. molasses diluted in 10 liters of water to make the solution. We add additional water depending on how dry the materials are. If we substitute manure for copra meal, the moisture is higher and we don't need as much water. However, the target is 40-50% moisture content. You get a feel for it after a while. We do the squeeze test. Just take a handful of your moist bokashi and squeeze it. If it crumbles in your hand after you release it, add more water. It should stick together without dripping when squeezed. This moisture will help fuel the fermentation process and prepare the ingredients for fertilizer use. It doesn't change form till it is buried in the soil.

Bokashi is a great soil conditioner and works well for side dressing. We also lay it on the surface before we mulch. It's a good nitrogen source when properly made. For field applications we make it with rice hull and cow manure. It's important to keep the C/N at around 30:1.

There are quite a few variations. Once you know what you are doing, try using the waste from your area. Use the waste that is economical. We have a bakery nearby with a continual supply of eggshells and ash. The coconut oil factory uses a heat extraction process to draw oil from the dried meat of the nut (copra). They sell this high nitrogen waste product; it makes great feed and excellent fertilizer. Grain mills put out a huge volume of waste products sorted into different grades.

Costing for Aloha Bokashi
(The deluxe copra meal version)

1 sack Copra meal	P	250.00
3 sacks D3	P	90.00
3 sacks RHC	P	90.00
EM & Molasses	P	5.00
TOTAL	P	435.00

This mix will yield 500L of high-grade fertilizer and it is pre-inoculated with EM; containing macronutrients, trace elements, minerals, bulking agents, and soil conditioning organic matter. That's 7 sacks of fertilizer, or P75.00 per sack. So what would you rather have for P1,000.00 pesos, 16 sacks of soil building bokashi or 1 sack of complete fertilizer?

Bokashi ferments kitchen waste and makes powerful fertilizer. It will ferment for 2 weeks.

At the orphanage we add the copra meal bokashi to our kitchen garbage and see great results. We buy the white 20-liter pails from

Dunkin donuts. We use one kilo of bokashi per 20-liter pail. We add the bokashi to the bottom of the pail to insure smooth fermentation. Then we add our kitchen wastes; things like peelings, bones, cooked food and old rice, layer by layer with the bokashi. We mix each layer of food waste with a stick. The key is to recycle at source. Set it up right in your kitchen. This allows the whole family to participate in the fun of creating your own fertilizers for producing your own vegetables or fruits. The results are worth the effort.

We pack it tight to keep out the oxygen. Anaerobic composting is always without air. This permits the lactic acid forming bacteria to go to work eliminating diseases. When the plastic container is full, just seal it up. It will remain airtight! We place it in the shade for 2 weeks. A label with the date is helpful.

Pour the fermented waste into a hole where you will plant your seed or transfer your seedling. Wait 2 weeks, and then transplant your seedling.

This container will not discharge liquids or cause odors because it is leak proof and air proof. This is the first stage in

anaerobic composting and it takes two weeks. Bury the fermented kitchen garbage in the soil. Mix some of the soil that you removed from the hole with the waste. This will assure decomposition within 2 weeks. Therefore, the full process takes only 1 month and it is ready to plant into. No wasted energy from methane gases/foul odors.

Mix with soil and cover for 2 weeks of decomposition then plant on top.

Because you bury it in the soil, it finishes decomposing without rotting or heating up. For large plants or tree seedlings, we dig a single hole, 30 liters in volume, and add our 20-liter pail of fermented kitchen garbage mixed into the soil from the hole we just dug. Make sure the top layer is pure soil so that you do not attract vermin. After 2 weeks the compost is finished. No turning. No fuss. Now you are ready to plant in it. This is a simple system for beginners if you can buy the bokashi from your EM dealer.

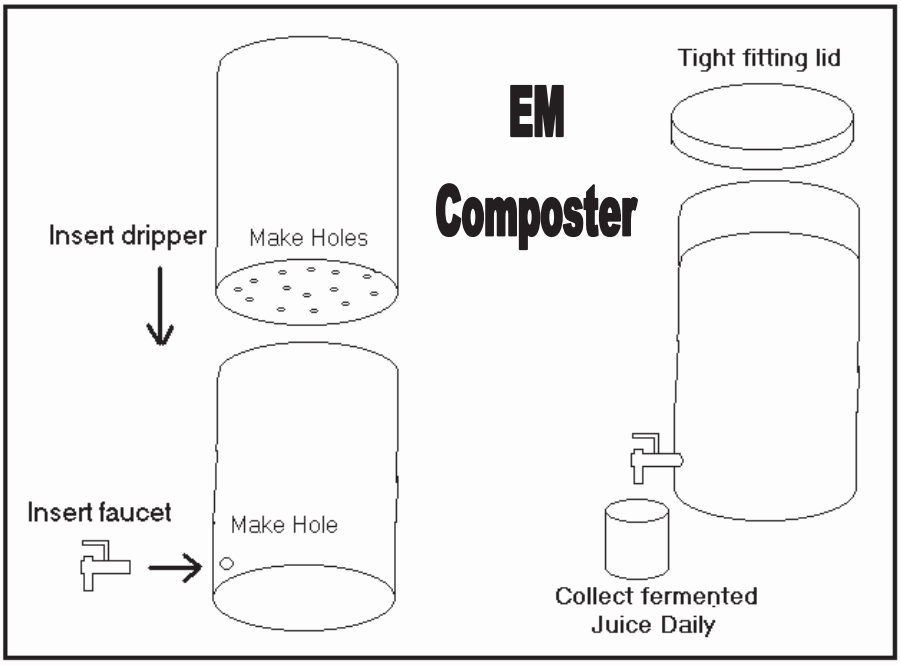
There must be phototropic bacteria (Rhodobactor sp.) to maximize the process and also prevent putrefaction (that's when pathogens dominate and cause a foul rotten smell). Lactic acid forming bacteria will biologically exclude or eliminate the pathogens through competitive exclusion. They out eat the bad guys. They starve them.

Our complete "at source" recycling system makes for profitable agriculture and a cleaner future. We capture all our household and farm resources and then utilize them. It turns waste into wonderful products.

These bacteria also break the dormancy of seeds, germinating them before they are in an oxygen environment. This prevents them from becoming weeds. Therefore, instead of expending heat to kill bacteria and seeds, the EM mixture will do it's job without taking energy away from the finished product. This is *synergistic*, synthesizing energy through productive processes that increase the

productivity of a system. It keeps the fertility in the compost without spending as much energy as aerobic composting.

We were able to harvest 200 kilos of papaya the first year; we used just 1 pail of fermented kitchen compost! The cost was P6 for 1 kilo of home made bokashi. Using our revolutionary papaya production system, we get 4-5 years from a tree and up to 1 ton of papaya fruits per tree.



Make your own composter for fermenting kitchen waste

You can collect a liquid fertilizer with the two-container system. Use the bokashi on each layer of food waste and mix with a stick. Then pack it tight to keep out air. When the plastic container is full, place in the shade for 2 weeks. A label with the date is helpful. Remove the liquid through the faucet daily and use in the soil as a fertilizer. It will also clean your septic tank, drains or canals if you

pour it down the drain. This liquid extract can be useful as a liquid fertilizer for potted plants and added to the watering system of various drip line schemes. It will add nutrients to the soil and bring the food down through the ground to the plant's root zone for efficient feeding. Use the garbage after 2 weeks like the previous method we discussed.

This is an incredible technology for entire municipalities. They can eliminate organic waste from the landfill. Cities can start programs at the school level. We have an entire curriculum for teaching it in the schools from the BOKASHI USA Network. Teach the young people and they will help implement it at the household level. You could pick a pilot project area and grow as you gain experience. Students learn to use microbial technology for home and commercial applications.

VERMICULTURE

When compost and organic matter is fed to "manure" worms they turn it into a more powerful end product called vermicast. It is in a form that is bio available, rich in beneficial microbial activity, and readily utilized by plants. When your feedstock is not pre-composted, it takes longer for the worms to eat it and may attract ants, mice and rats as well as cause odors. Make sure to use a broad spectrum of organic matter to keep the worm population healthy.

Vermiculture is part of our advanced training, as it requires specialized management, a hands-on portion, and detailed information. Nevertheless, the main points are as follows: of utmost importance are air (oxygen), moisture, bedding and feedstock. The bed is 18" deep and varies in sizes from 3X3 ft. to 4X8 ft.

Composted crop residue is excellent feedstock for your worms.

My wife's natural beauty competes with the beauty of 200 kilos of papaya on one tree.

Papaya grow well in vermicasts, but you need the right worm. There are many varieties of worms, but two main groups: soil workers and composters. You want to use the composters in a vermiculture project that produces natural fertilizer. They flourish horizontally, on the surface, in high concentrations of organic waste.

A proud farmer holds up a harvest grown in our vermicast potting soils. She is the potting soil queen at Aloha House.

The soil workers live vertically in burrows, needing a high soil environment. They are very helpful in the garden and farm, aerating soil increasing the drainage and fertilizing plants. You want to encourage them in your soil, see the chapter on minimal tillage for more tips on utilizing this resource. However, they will die in your worm farm. In our system we use African night crawlers, an excellent manure worm. I've gathered water buffalo dung in the pasture and propagated the manure worm resident to the Philippines; it took longer than the imports, but is an alternative.

The vermi-condos at Aloha House are integrated into the flow of the garden and farm. The kitchen waste comes from above and the vermicasts are harvested and transferred down the hill to the nursery.

We top harvest the casts every week from the surface of the bed. This yields a pure fertilizer without our having to hand sort the worms or screen out the finished product. Humans live above their

waste; worms live below it. They travel to the surface and leave behind some of God's best natural fertilizer. We use it for our potting mix. We get about 2-3 inches (10-15 cm) from the surface if everything is properly managed. Our yield is based on the surface area of the bed, depth does not significantly increase yield. The deeper the bed, the more compact it gets, and this can lessen the activity from your crawling friends down below.

With 1 liter of vermicasts per square foot per week you can start to see the size of the project. That might help you estimate your area requirement for the amount of vermicast you set as a goal to meet your nursery needs.

We have 10 beds totaling 151 square feet. Our weekly yield averages 8 pails (times 20 L/pail), or 160 Liters. We harvest 1 liter per square foot per week!

Sign up for an internship and you can learn how to manage your own vermiculture. You will be able to transfer valuable experience to your project. Learn by taking care of an established operation.

Technically, *vermicasts* are the pure fertilizer from the worms. *Vermi-compost* is usually an undisclosed mixture of livestock manure, worm bedding and vermicasts. If you buy vermi-compost you are not getting your money's worth. Some unscrupulous dealers prematurely run their vermi-compost through a screen when the worms have processed about 30% of the feedstock and bedding. That means your buying 70% glorified cow manure at inflated prices. Buy only vermicasts from trusted growers. Better yet, make your own.

After our weekly harvest we use a garden fork to insert air without turning the bedding. This minimizes compaction and keeps the worms active without disturbing them too much. We also insert some carrot fiber from our daily juicing habit. Each day we add the 2-3 kilos of fine fibers to a different bed. We may also soak this in molasses to encourage breeding if we want to replace the worms we sold that month.

Then we put a thin layer of mulch back over the top to encourage daylight activity. Next, we spray it all down with water to keep the moisture level high, around 50-70% moisture content. The evaporation keeps our worm-bedding cooler, which is important for our tropical setting.

Some worms will actually crawl out and try to live elsewhere when the conditions are bad. If the mulch is too thick the airflow is limited. They will evacuate. Soggy bedding and heat from raw manure will drive them out too. Sometimes in the morning we find dead, dried worms around our beds. That tells us that something is wrong. We examine the bedding, moisture and mulch and quickly adjust before we lose them all.

The bedding is composted animal manure. We use it to cover our feedstock, which consists of 20-liter pails of fermented kitchen garbage. They eat it all eventually, even if you use newspaper or cardboard for bedding. Keep it covered to prevent ants from visiting.

So there you have it. Air, water, feedstock and bedding. Your worm project can complete your fertilizer program and save you pesos! Use the right species of earthworm for the task at hand. What's important is that you do your homework and find a system that works best for your project. Start small, grow into to it as you gain experience and master the practices you need to succeed.

These beds are 3X4 feet and 1 foot deep.

Every week we top harvest the vermicasts to assure the highest quality yield, and then we aerate the bed gently with a garden fork.

A ball valve controls the water flow so that workers can run the sprayers for all the beds at once, without having to open them and manually water.

We seldom disturb these silent workers from below. This photo makes the African night crawler look more glamorous than it actually is. It turns garbage into fertilizer. We grow them to make a high-grade additive for our potting soil.

We tested it at the D.A. (Department of Agriculture). The PH is 6.8, and the 3 macronutrients, NPK, are 1.5-1.4-1.5. It's ideal as a fertilizer or compost because of the trace elements it contains as well as the microbial activity. The tested value is secondary to our purposes.

The end product is profitable to sell and can be made into a foliar fertilizer.

Chili and bell peppers do really well in the vermicasts made from our fermented kitchen garbage. The red chili is packaged and sold to restaurants on our island as well as the one grocery store in town; --they call it a "supermarket". We also have customers drop in for some of our specialty items.

The herb crew fills another order for the local market. We sell Indian coriander, cilantro, sweet basil, lemon basil, Thai basil, Chinese parsley, dill weed, garlic chives, onion chives, 3 chili varieties, celery and lemon grass.

Herbs can be very profitable. Each one requires special study and testing, but it's always rewarding to see it on the store shelf. We wholesale to a store that supplies all the hotels and restaurants that use herbs in their dishes. It's convenient for the chefs to get their menu items all at the same place.

Chinese Parsley grows in a vermicast potting mix. Lettuce starts in 20% vermicast potting mix for 3 weeks; it finishes in our raised beds for 4 weeks.

Commercial vermicast production is taking off in Palawan. PCART has a small operation near Roxas. We even feed some of our worms to livestock to supplement protein requirements.

The mungo bean is famous in the tropics as a green manure. It has maximum biomass in the shortest amount of time. At 30-40 days from planting, it can be incorporated back into the soil to feed the next crop.