Hawai‘i Island Meat Cooperative
Composting Guidelines

What is Composting?

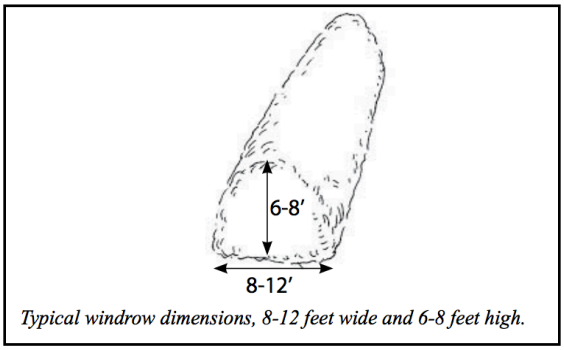
Composting is a natural process in which microorganisms convert organic material into a stable product called compost, which can be applied to land as nutrient-rich fertilizer. To compost slaughter byproducts (i.e. inedible offal, bones) – called *residuals* in the context of composting – the residuals are completely surrounded by a bulking agent such as sawdust that is high in carbon. Once covered, anaerobic microorganisms work to degrade the residuals, releasing fluids and odorous gases such as hydrogen sulfide and ammonia. These diffuse into the surrounding bulking agent. In this bulking agent, aerobic microorganisms degrade these materials into odor-free carbon dioxide and water. The aerobic process produces considerable heat, causing the temperature of the compost pile to rise. The active bacteria in both the aerobic and anaerobic zones are heat tolerant. However, the heat kills common viruses, bacteria, and pathogens that may be present. Odor is controlled by having an adequate amount of bulking agent around the residuals.

Benefits of Composting

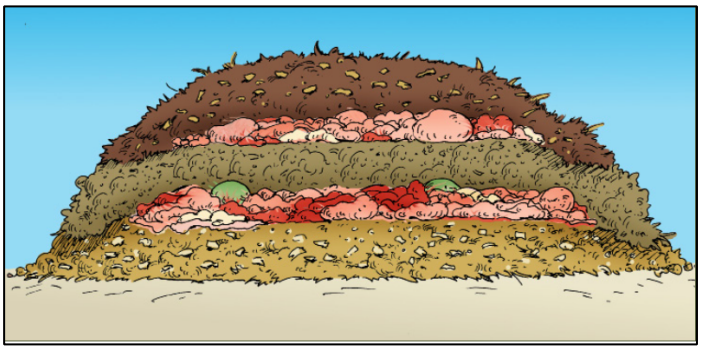
There are many benefits to composting slaughter residuals. Composting requires relatively low labor, minimal start-up and operating costs, is practically odor-free, can be done with common farming equipment, and turns a waste into a beneficial fertilizer and soil amendment, resulting in on-farm nutrient recycling. Regularly turned compost is used mostly for small animals and poultry, and is more labor intensive as it requires three solid-base bins for the different stages in the composting process. *Aerated static pile composting* is recommended for larger animals such as pigs, goats, sheep and cattle, as a more easily managed composting technique.

Aerated Static Pile Composting Method

In aerated static pile (ASP) composting, the residuals and carbon material (i.e. sawdust, wood chips, etc.) are layered and no mixing is done until after the active phase of composting has occurred and the residuals are fully decomposed. The practice does require space on your land to construct the compost piles and takes from two to six months (60-180 days) for the residuals to decompose. The most common and efficient method is in windrows, but it can also be done in piles or bins for smaller amounts. Windrows are elongated piles that can vary in size and spacing. A typical windrow is 8-12 feet wide by 6-8 feet high by as long as space allows. Windrows can be built over time and extended when the need to add new residual arises. See images below:



Typical windrow dimensions, 8-12 feet wide and 6-8 feet high.



Drawings of typical windrow dimensions (left) and a windrow cross section (right) showing residuals layered with bulking agent. Source: Cornell Waste Management Institute, 2010

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How to Start an ASP Compost Site

1. Select a site on property that is well drained, at least 200 feet from watercourses, sinkholes, seasonal seeps or other landscape features that indicate the area is hydrologically sensitive. Make sure all areas used for composting, curing and storage are located on surfaces capable of minimizing leachate release into groundwater and surrounding land surface. *For help determining whether your location is appropriate, contact your local NRCS or UH-CTAHR Extension office, or call HIMC's manager and we'll help connect you to the right resources.*

2. Lay a 24 inch deep bed of bulking agent (i.e. sawdust, wood chips) 10-12 feet wide and as long as space permits to allow for 1-2 months of residuals, based on your processing needs. *For help determining how much space you'll need, see table on following page, visit the Resources page on HIMC's website (which includes several online space calculators), or contact the organizations listed above.*

3. Spread a 12-15 inch layer of residuals, then cover with a 12-18 inch layer of bulking agent, add another layer of residuals and cover with 2 feet of bulking agent. The finished section should be 5-6 feet high. In the finished compost pile, the residual should be surrounded by at least 12 inches of moistened bulking agent or finished compost – which can serve as additional insulation, prevent odor and deter scavengers.

4. When incorporating large amounts of blood, make sure there is plenty of material to absorb the liquid. Make a depression so blood can be absorbed and then cover with bulking agent. If a blood spill occurs, scrape it up and put it back in the pile.

5. Let compost sit for 2-6 months, then check to see if the residual is degraded. For proper decomposition and pathogen kill, the pile must be insulated (covered with a layer of bulking agent or finished compost) and a temperature of not less than 131˚F (55˚C) must be maintained throughout the pile for at least 3 consecutive days, monitored 6-8 inches from the top of the pile towards the center. For best results, measure the temperature of the pile regularly until the desired temperature is achieved for 3 consecutive days. After this active, hot phase, the compost should go through a "mesophilic" stage of 77-104˚F (25-40˚C) to finish the composting process.

6. Large bones usually do not completely break down in one compost cycle. Bones from immature animals degrade very quickly, but bones from mature animals (e.g. cows over 24 months) take several cycles to break down. After the material is composted, bones can be reused as part of the base for the next compost pile; they add structure, pore space and air flow. Make sure to remove any remaining large bones before applying your finished compost to land.

7. Site cleanliness is the most important aspect of composting. Keeping your piles properly insulated with no exposed waste will deter scavengers and help control odors, in turn keeping good neighbor relations.

8. Finished compost may be used on crops such as hay, corn, tree plantations and forestland. It is recommended to use a portion of finished compost in the creation of your new compost

pile. This reduces the amount of bulking agent you need in the new pile and provides microbial inoculant that spurs the composting process. Applying compost to "table-top" crops directly consumed by people is not recommended. Nutrients in carcass and residual composts are higher in the nutrients N, P and K than compost containing only plant material, giving it more fertilizer value.

Other Considerations:

- **Manure:** Manure can also be used in the compost pile but is not necessary. Manure tends to be high in nitrogen and low in carbon. The advantages of using manure are that it adds microorganisms to the pile, adds nitrogen which can help speed up the composting process, and adds moisture. The disadvantage is the danger of excessive nitrogen in the pile resulting in odor, flies and other composting problems.
- **Weather:** In rainy areas it is important to keep piles from getting too wet because that encourages the anaerobic microbes that generate foul odors. In wetter climates, piles should be designed with steep, pointed crowns and sloping sides to shed rain rapidly.
- **Space:** Composting requires space to construct the windrows, store the carbon material, and if a finished product is desired, for curing and storage of that product. Exactly how much space depends on the amount of residual generated and of carbon needed; 1 cubic ft of bulking material is generally recommended for every 4-6lbs of slaughter residual. To get a general idea how much space you'll need, the following table shows average space required for composting of slaughter residuals from cows, pigs, or sheep and goats. More detailed calculations can be made using one of the compost space calculators referenced on the following page and available through HIMC's website. Note that total space required for storage of raw materials and curing of finished product is estimated at between 1.5 and 2.5 times the area required just for composting.

Animal	**Space needed for 1 animal**	**Space needed for 1 animal per week (52 animals/yr)**	**Space needed for 15 animals per week (780 animals/yr)**
Cow	14.3 sq ft	743.6 sq ft,	11,154 sq ft (0.25 acres)
Pig	1.6 sq ft	83.2 sq ft	1,248 sq ft (0.029 acres)
Sheep or Goat	1.1 sq ft	57.2 sq ft	858 sq ft (0.02 acres)

Note: calculations assume 1 cubic ft of bulking material per 5 lbs of residuals; space requirements estimated for composting only.

Supplies and Tools Needed

1. **Bulking agent:** Material that is absorptive, porous and high in carbon. Sawdust has been widely used and has excellent odor-absorbing potential. Other bulking agent options include straw, hay, and small wood shavings. The bulking agent must be available consistently and in high enough quantities from one or more sources throughout the year. You will need about 1 cubic foot of the material for every 5 pounds of residual composted.
2. **Thermometer:** A probe-type thermometer with a minimum 36-inch stainless steel stem is needed to monitor the pile. A recommend thermometer is the 48-inch Heavy-Duty Windrow Thermometer (www.reotemp.com). Other manufacturers marketing good quality probes

include Geneq (www.geneq.com), Omega (www.omega.com), Tel-Tru (www.teltru.com) and PTC Instruments (www.ptc1.com).

3. **Composting Log:** A logbook is needed where you can record dates and weights of residuals placed in the compost pile, temperature readings, amounts of bulking agent used, and dates and amounts of finished compost.
4. **Front-End or Skid Steer Loader:** The loader is helpful for moving residuals from the slaughter unit to the compost site, to cover the carcasses with bulking agent, to move remaining bones to new compost pile and to move finished compost.
5. **Manure Spreader:** A manure spreader is recommended for field spreading of finished compost.

References

The following references are available for free by calling HIMC's manager or visiting the Resources page of our website at http://HawaiiIslandMeat.com/Resources/.

- *The Space It Takes - Footprint Calculator for Composting Butcher Waste* by Cornell Waste Management Institute, 2010.
- *Natural Rendering: Composting Livestock Mortality and Butcher Waste* by Cornell Waste Management Institute, 2002; 2008.
- *Key Points of Static Pile Carcass Composting in Reference to Natural Rendering: Composting Livestock Mortality* by Cornell Waste Management Institute, 2002.
- *Key Points of Static Pile Butcher Waste Composting in Reference to Natural Rendering: Composting Butcher Waste* by Cornell Waste Management Institute, 2002.
- *Composting Animal Mortalities* by Minnesota Board of Animal Health, Minnesota Dept. of Agriculture, and University of Minnesota Extension Service, 2009.
- *Environmental Engineering National Engineering Handbook, Ch. 2 Composting* by USDA & NRCS, 2010.
- *Composting dead livestock: A new solution to an old problem* by Iowa State University Extension Office, 1999.
- *Composting Large Animal Carcasses* by Texas A&M University System's Texas Cooperative Extension, 2006.

Composting space calculators

Several calculators are available to determine how much space is needed to compost slaughter residuals. Both of the following are available for free download through HIMC's website.

- *Co-Composter Model* by Cornell University's Department of Biological and environmental engineering and Cornell Waste Management Institute, 2001: http://compost.css.cornell.edu/CoComposter.xls. Note: when calculating for slaughter residuals start with question #8 on the user input page.
- *Spartan Animal tissue Composting (ATC) System Planner* by Roseboom, Person and Kreigel at Michigan State University, 2009: http://msue.anr.msu.edu/program/managing_animal_mortalities/composting_tools.