On-Site Composting of Meat By-Products

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I. Background

Meat processors and livestock operations face an increasingly difficult climate with regards to rendering and other types of disposal for animal processing residuals. Historically, renderers purchased some meat by-products and recycled these materials into animal feed supplements, fertilizer, soaps, gelatins, pharmaceuticals and lotions. The concern over BSE (Mad Cow Disease) and the energy intensive meat scrap recycling process have led to the decline of the rendering services in NY. Furthermore, consolidation in the rendering business has led to increased transportation costs, and depressed grain prices have made corn and soy beans attractive as replacements for meat by-products. Smaller butchering operations face additional challenges as rendering companies are less willing to collect meat by-products in small volumes (Seaman, 2001).

During the summer of 1999, Mapleton Farms Country Butcher Shop decided to pursue an alternative strategy for managing its animal residuals and meat wastes. Mapleton Farms applied to and received $53,550 from New York's Empire State Development Corporation to research, develop and demonstrate the viability and economics of composting meat scraps with other available wastes on-site as opposed to paying a renderer or waste hauler to manage them. Up to 60% of live animal weight must be disposed of in some fashion. The dense, wet and putrescible nature of the mixed slaughterhouse waste makes it undesirable to store for long periods of time, difficult to dispose through commercial waste hauling services, incineration or other means. All options are expensive and rendering charges to small butcher shops in parts of NY increased by 50% to 300% during the project period, January 2000 to August 2001.

Mapleton Farms Country Butcher Shop is a small custom slaughterhouse on a 150-acre farm in the Finger Lakes region. Mixed slaughterhouse waste is produced daily at this and other butchering operations. The rendering company that formerly collected meat by-products refused to pick up materials such as blood, paunch manure, and other offal since there is no longer a market for this material. The project team consisted of farm owners Jeff and Darci Gulliver as the primary contractors; Tim Delaney, butcher shop manager, as contractor staff; Brian Jerose of Environmental Fertilization Corp., as the primary subcontractor; and Kelly Sevier, of Cornell Cooperation Extension, as a subcontractor.

Developing a environmentally safe and cost-effective process to handle mixed slaughterhouse waste could ultimately provide increased productivity and competitiveness for this and other NYS businesses while increasing capacity for recycling. Valuable nutrients are found in mixed slaughterhouse waste, and of particular interest, nitrogen. To landfill or incinerate these nutrients is wasteful and objectionable considering the amount of feed, resources and energy put into raising the livestock. A viable alternative may reduce the risks of pathogenic and nutrient pollution for those operations that bury or dispose meat scraps and animal mortalities by other means. This project explored the economic viability and technical obstacles to on-site composting of meat by-products with horse manure, leaves and wood chips using existing farm equipment. The decomposed material was spread on hay fields of the 150-acre farm to assess the ability to utilize this material as an organic soil amendment.

II. Learning Targets

RD&D LEARNING TARGETS:

1. Determine the costs/cost-savings related to the on-site composting of mixed slaughterhouse waste using commonly available feedstocks, bulking agents, farm equipment and facilities

2. Identify the best mixing ratios, operational procedures, equipment and handling methods to accomplish cost-effective nuisance-free composting of mixed slaughterhouse waste in an outdoor windrow compost operation

TARGETS FOR ULTIMATE RESULTS: Divert over 100 tons per year (tpy) slaughterhouse waste from disposal or rendering and save Mapleton Farms Country Butcher Shop at least $8,500/year in waste management costs as well as about $500/year in the avoided cost for soil amendments on their farm. This project will serve as a model for other slaughterhouses, grocery stores, or food processing facilities in New York that face similar waste management problems/costs. A workshop providing technology transfer of the outcomes of this project has been built into the project.

III. Methodology

<u>Task One</u>: Divert over 100 tpy of butcher shop waste from landfills or rendering services through on-site composting of materials.

Steps Taken: Three outdoor windrow composting methods were used to blend meat scraps, leaves and woodchips, and horse manure. All methods utilized a 4-wheel drive John Deere tractor with a 1 cubic yard (cy) bucket loader to move materials. Incoming bulking agents and amendments are tipped on to a prepared shale pad behind the existing hay barn. The leaves, woodchips and horse manure are pushed into piles of each other material to activate the composting process in these feedstocks. For building new compost windrows, these feedstocks are set at the base a minimum of 18 inches deep. The meat scraps are placed on top and in the center of the base and then covered with a minimum of 12 inches of amendments. This process is repeated until obtaining an approximate windrow size of 8 feet in height, 18 feet in width at the base, and up to 150 feet in length (longer is possible). Additional meat scraps may be added into an actively composting windrow by opening a trough in the center of the windrow. After meat scraps are loaded in the windrow, they must be covered again with a minimum of 12 inches of amendments. For additional details please see Appendix A: Composting Information Sheets, Windrow Construction.

Outcome: The Mapleton Farms Country Butcher Shop in Union Springs, NY, effectively composted over 170 tons (approx. 115 tpy) of meat scraps generated from their slaughterhouse and butcher shop. During the project, an additional 250 tons of ground leaves and woodchips and 200 tons of horse manure were also composted. The aged compost was screened and then approximately 140 tons of screened compost was applied to hay fields on 28 acres of the farm.

Meat scraps weigh approximately 1500 lbs. per cy, therefore 1 ton = 1.33 cy. Leaves and woodchips weigh approximately 1000 lbs. per cy, therefore 1 ton = 2 cy. Horse manure weighs approximately 1200 lbs. per cy, therefore 1 ton = 1.67 cy. Finished compost weighs approximately 1000 lbs. per cy, therefore 1 ton = 2 cy.

Unexpected Results: The development of material handling processes that achieved the most rapid initiation of composting activity in the meat scraps resulted from observing the different extents of decomposition in different sections of the windrows. Sections of the compost windrows had improved performance in terms of thermophilic temperatures, reduced odors and size reduction when either compost from previously existing compost windrows or horse manure that was already heating, was used in the compost mixture. Other mixtures that included the same feedstocks that had been separate until windrow construction with the meat scraps achieved adequate composting characteristics but at a slower pace. Minimal handling of the horse manure and leaves and woodchips on the shale pad to encourage some level of homogenization and contact was a simple step that improved the overall process.

<u>Task Two</u>: Collect materials for compost blends, document sources and volumes and take feedstock samples.

Steps Taken: Ground brush consisting of leaves and woodchips was received from NYSEG utility line clearing crews, a private tree service company and the Town of Fleming. Horse manure was collected using a farm truck and trailer from local horse stables in the Towns of Scipio and Fleming, less than one mile from the farm. Meat scraps, offal and animal mortalities were generated on-site in the slaughterhouse and butcher shop. Meat scraps were stored in barrels in an attached shed and brought out to the compost site regularly, often on a daily basis.

Brian Jerose and Jeff Gulliver, using a six-grab sample composite from representative portions of the various materials, collected samples of each waste. The samples were submitted to Dairy One, DHIA Forage Testing Laboratory in Ithaca, NY. The samples were analyzed for Nitrogen (N), Phosphorus (P), Potassium (K), solids, available carbon (C) and organic matter content.

Barrels of slaughterhouse waste were loaded into the 1 cubic yard bucket prior to composting allowing for a good estimation of volume. Weights were tracked using the slaughterhouse scale (J-Star Agricultural Scale, 4000 lbs. capacity), with barrels typically weighing 200 to 300 lbs. Mixing of other amendments using the same bucket allowed for measurements of horse manure, and leaves and wood chips utilized. Weights for amendments were estimated from typical values found in literature (NRAES, 1992).

Outcome: The results from feedstock sampling were used to refine the compost recipe and feedstock proportions that had been developed using estimated values. The meat scraps were generally high in N, the leaves and wood chips were highest in organic matter content, and the horse manure provided both N and C. The detailed test results may be found in Appendix B: Laboratory Analyses, Feedstocks.

The recipe we decided upon had a C:N ratio of 36:1 and an initial moisture content of 63.5%. This formulation worked well in terms of providing desirable adequate carbon for decomposing the meat scraps. Since the materials were not entirely homogenized, it was determined that adding carbonaceous materials (leaves, woodchips and bedded manure) to achieve a ratio higher than the recommended 25 or 30:1 would achieve desirable conditions on the interior of the windrows. The additional carbon materials that are layered on windrows for control of odors and vector attraction increase the C:N ratio.

N, P, and K are sampled for to determine the levels of macronutrients necessary for plant growth. The available C and organic matter tests are interchangeable and help to determine the proper C:N ratio. The solids content of feedstocks allows the determination of available nutrients for the blending ratio and the proper mixing ratio of feedstocks for total moisture content. Moisture content is simply the 100% minus the solids content.

Unexpected Results: The meat scraps were higher in N and had a lower C:N ratio than what was suggested in the literature (Northeast Regional Agricultural Engineering Service (NRAES), 1992). The project team had confidence in the results as three composited samples consisting of six grab-samples each, for a total of 18 different material specimens, were submitted to the laboratory. Analytical results were consistent between the several composited samples, supporting our belief that we had properly sampled the feedstocks.

<u>Task Three</u>: Construct three formulations and methods to compare composting efficiency.

Steps Taken: The research involved in the process included testing three low-input compost processes using existing farm equipment. An emphasis on nuisance-free compost site conditions was made, rather than the production of high quality compost suitable for retail sales. A detailed compost site operation and maintenance plan was created for Mapleton Farms and this may be used as an example for other meat scrap and mortality composting operations. See Appendix C: Compost Site Operation Manual.

The three compost processes consisted of 1) windrow turned on a monthly basis; 2) windrow turned on two-month schedule; and 3) static windrow with passive aeration provided by 4" perforated pipe set 12 inches from the bottom of the pile, eight feet apart.

Outcome: The compost site maintained nuisance-free conditions throughout the project period. Odors were strongly evident on one day of turning windrows during the third month of the project (mid-April 2000). It was determined that low decomposition rates in a portion of a windrow led to some anaerobic conditions and resulting negative odors. The windrow was quickly covered with carbon amendments and the odors abated. The problem was avoided for the duration of the project with improved windrow construction, mixing with greater volumes of carbon amendments and covering windrows with additional carbon amendments.

The windrow turned every other month had decomposition rates similar to the windrow turned monthly. The static windrow had much slower decomposition with some meat scraps still identifiable after 12 months of composting. The perforated pipes became filled with animal fats and grease, failing in their ability to supplement aeration of the windrow. All windrows needed additional turning after six to twelve months of composting to be acceptable for screening and land application.

Unexpected Results: The two-month cycle for initial turning of the windrows was the most efficient method for meat scraps composting. The project team believes that if meat scraps are placed into an actively composting windrow, it is most desirable to turn the windrows minimally in the first four months. This allows time for much of the readily decomposed meat by-products to be converted to more stable, less odorous materials. However, in order to achieve a compost quality that is more mature, more frequent turning of windrows is necessary through this second stage of composting. Attempts to maintain adequate moisture for microbial decomposition should be taken or otherwise the process will remain slow. If windrows are too dry then water or dilute liquid dairy manure should work well to reactivate the composting process. This method was successful when attempted on another meat scrap compost windrow on site that was not part of the three-method comparison.

This turning regimen is nearly opposite of the recommended practices for food scraps and manure composting. Food scraps composting for turned windrows is recommended to have windrows turned five times during the first 15 days and then less frequently as the material matures. For meat scraps we now recommend turning windrows every other month for the first four to six months and then more frequent turning in the last two to four months of composting with additional curing time if necessary.

Covering the windrows regularly with additional amendments was necessary to avoid the exposure of meat scraps at the surface of the pile. The expansion of gasses in the organs of the butchered animals and the scavenging of crows occasionally exposed meat scraps. These sections would be cleaned-up and covered with carbon amendments. The covering of windrows and shooting of one crow and hanging it near the site reduced further attraction of crows to the site.

Task Four: Document adjustments and refinements to collection of bulking agents and amendments, operation of equipment and suitability of composting surface.

Steps Taken: Originally the horse manure and ground leaves and wood chips were stockpiled adjacent to each other and then combined in the windrows with the meat scraps. Since June 2000, the horse manure and wood chips have been stockpiled together and homogenized to a small degree. As the loads are delivered, the bucket loader pushes the new feedstocks into the larger pile and turns the material over.

The project team periodically reviewed equipment and site conditions. Implemented changes in operating practices were then reviewed for their improvement or effect.

Outcome: The effect of mixing horse manure and ground brush is to initiate thermophilic composting in the feedstocks on the shale pad. Temperatures, while not entirely even, have been observed from 100 to 140 degrees Fahrenheit. This accomplishes several positive steps. Potential anaerobic odors from the wet, dense horse manure bedded with sawdust are abated through the mixing process. The coarser particles of the wood chips lend to better pile structure, improved passive aeration and additional available carbon. Second, the generation of thermophilic activity indicates the presence of thermophilic microorganisms in the feedstocks. As these materials are mixed with the meat scraps in the field windrows, rapid decomposition with desired microorganisms can take place. Third, as the horse manure and wood chips are already partially homogenized, this promotes more even composting in the field windrows and helps to avoid hot and cold spots. Lastly, the thermophilic decomposition observed in the feedstocks helped the composting of the meat scraps through the colder winter months by maintaining higher initial temperatures for mixing in meat scraps. No freezing of piles was observed as windrows melted any accumulated snow and composting activity was maintained.

The bucket loader tractor has proven to be effective and versatile in the implementation of the project. It is capable of collecting meat scraps barrels, turning piles, maintaining feedstock piles and forming windrows. The one cubic yard (cy) bucket on the tractor is sufficient for this scale of operation. The four-wheel drive (4WD) was extremely useful during winter, wet and muddy periods of the year. The tractor had enough traction to turn piles and move heavy materials. During the summer months 4WD is helpful but not critical to have. The equipment has been easy to maintain mechanically. Cleaning the equipment has been important as materials and their odors cling to the tires. Some of the fats that are liquefied during the hot composting phase can escape the wood chips and fall on the ground. This portion of the waste stream is odorous, sticky and needed to be cleaned off of the equipment. We have attempted to avoid this problem by providing a thicker base of old compost and combined horse manure/wood chips below any meat scraps in the windrows. This helps to trap and contain liquids, fats and blood. So far this has been effective in reducing the escape of fats and liquids from the windrows.

Regarding the site, the shale pad has worked well for stockpiling materials and was used for some of the meat scraps composting before the three comparative composting trials began. The surface held up well and was easy to drive on during snow, mud and wet conditions. It is currently used for stockpiling carbon sources and bulking agents.

The active windrows composting the meat scraps were in a field, as are windrows that continue to be formed following the completion of the comparison. A section of a field used typically for hay, while in a wheat/straw rotation, was dedicated for the composting site. The surface has become firm as it has been compacted by the tractor during forming and turning of the windrows. Even in the above average wet and very rainy year of 2000, the site did not exhibit rutting or muddy areas. The soil directly beneath the windrows is soft but dries out after the windrows have been turned. The soil type is a moderately well drained Honeoye silt loam with gravelly loam subsoil.

From a cost and performance perspective the use of the field soils has been most desirable and more than adequate for the scale of the operation. Long-term questions about impacts on groundwater cannot be answered at this point. It is very likely that at this scale, the load of nutrients is minimal and less than conventional agricultural practices related to manure spreading and fertilization. We recommend at a larger scale that either an impermeable liner is used for all of the site or for the initial composting mixing and processing, or that the compost site be rotated to different fields as crops would be rotated. It should be noted that composting on field soils is site-specific and that not all operations will have suitable slope, stability, drainage and separation distance from surface water, groundwater and other resources. In addition, it may be desirable to install a vegetative barrier of trees for visual aesthetics and potential odor mitigation.

Unexpected Results: Appearance of grease on the ground beneath and at the bottom of windrows that clung to the tractor tires was unexpected. Cleaning of the tractor and an increase in the depth of the carbon amendments at the base of the windrows helped to reduce the effect of this nuisance. In the future, it may be desirable to remove as much fat as possible from compost piles if another viable use for animal fat can be developed.

Runoff from any windrows was extremely rare over the course of the project since the piles tended to be slightly dry. While the initial moisture content was nearly ideal, the amount of microbial activity necessary to decompose these high strength wastes likely utilized a greater amount of moisture than manure, food scraps and yard waste composting typically would consume. Therefore the lack of moisture likely slowed the decomposition process. However when runoff did appear adjacent to windrows after applying wash water or after heavy rains, the runoff killed grass. This may be attributed to high concentrations of nutrients. This adds weight to the argument that compost sites should be rotated on fields to prevent nutrient overloading in certain areas.

<u>Task Five</u>: Screen composted materials, obtain equipment and spread compost on fields.

Steps Taken: An orbital screener was rented for the screening of the compost prior to application to the farm fields. The screener was locally available from another project in Central New York, Toad Hollow Farms Natural Compost, run by William Guptill. The lime spreader for applying the screened compost was rented from Genoa Ag Equipment.

Outcome: The screener was capable of removing coarse woodchips, most bones and other large particles. The machine achieved a yield of approximately 70% of volume passing through the $1^{1/4}$" screen. The rate of screening was up to 20 cubic yards per hour during operation. The compost was drier than many composted materials, ranging from 20 to 38% moisture. The materials were actually dry and dusty, demonstrating a loss of some material fines and evidence that some of the microorganisms that support soil aggregation may have been lost to desiccation. This likely improved the rate of screening but may have resulted in immature compost that did not fully mature due to a lack of adequate moisture.

The lime spreader was capable of applying the composted materials without clogging or binding. The material was applied in a uniform fashion without noticeable clumping of materials in the fields. The presence of hammers on the expeller discharge likely improved the uniformity of the compost application.

Unexpected Results: A greater percentage of bone material passed through the screener and was able to be applied to the fields than anticipated. Many bones became brittle through the composting process and disintegrated in the handling process without any intentional grinding. The bone flakes were effectively spread with the rest of the composted material and did not leave noticeable evidence of bone in the fields. Larger bones such as skulls were collected in the screener with other large particles. These screened overs are being recycled into new compost windrows. Teeth that do pass through the screen may be the only potentially hazardous material to equipment tires after being spread on the fields. The teeth do not readily decompose and some remain sharp. No problems have been observed yet.

Task Six: Collect preliminary and final samples for nutrient value and characteristics. Obtain and implement crop consultant recommendations for nutrient management, application rates and grass selection.

Steps Taken: Samples were submitted to Dairy One Forage Laboratory in Ithaca, NY in September 2000 and July 2001. Agricultural Consulting Services (ACS) of Rochester, NY collected soil samples from farm fields to determine nutrient and organic matter needs for the hay crop growing on the fields. A compost sample was sent to Woods End Research Laboratory in Mount Vernon, ME for analysis. This analysis included nutrients, maturity and other characteristics. Dick Dale, Certified Crop Advisor for ACS provided recommendations for grass species, application rates and practices that would allow the farm to transition to certified organic production in the future, if desired. See Appendix B: Laboratory Analyses.

Outcome: Compost samples were determined to be higher in N (1.9 to 2.2%) than most other farm-produced composts with moderate levels of P and K. Typical manure-based composts may have NPK levels of 1-1-1 or 0.5-0.5-0.5. The Woods End analysis also determined that the compost applied to the fields was immature and could have decomposed further with adequate composting conditions. This may be attributed to the lack of moisture present in the windrows as the materials matured and respiration of organisms in the compost released moisture from the windrows.

The compost was spread at a rate of five tons of compost per acre. Approximately 140 tons of screened material was spread on a 28-acre section of the farm. Alfalfa, orchard grass, and timothy were selected to reseed the field following the wheat rotation of 2000. This grass mixture was chosen for its ability to take up N from the soil, considering the compost application was rich in N. This grass makes quality hay and the orchard grass with its high N uptake will become established as the alfalfa crop passes.

Unexpected Results: We anticipated higher phosphorus levels in the finished compost from the presence of bones. However it is likely that the coarse bone particles that were spread on the fields were not assayed in the laboratory tests because of size limitations. Therefore the phosphorus present in the bone matter will become available to plants and soils over the coming years and the matter is further decomposed in the fields.

Sampling and analytical variation of the compost was observed to some degree throughout the project. It is likely that the mixed nature of the waste, combined with laboratory unfamiliarity with this type of material used in a composting application led to some variation in laboratory results. This would be anticipated to change over time, as individuals collecting samples and laboratories performing analyses become more experienced. Excellent communication between the laboratory, the project team, and the crop advisor allowed all parties to build experience and knowledge through this project.

Task Seven: Assess any equipment and facility used, what is needed to best complete the tasks for on-site composting of meat scraps and amendments, include economics.

Steps Taken: Hours were recorded for the labor spent by different project team members on various project tasks. In particular, hours of equipment operation using the bucket loader tractor and rented equipment were documented to gain an understanding of the expense of managing a compost site.

Outcome: The equipment and site worked well for the scale of the project. See *Task Five* for more details. The cost-sharing from EMIG made the project economically viable during the learning phase of the project. Improved planning of materials handling should reduce future costs for screening and spreading materials.

It is projected that to continue composting will require approximately 220 hours of labor and administration per year, including 150 hours of tractor operation. At a labor rate of $20/hour, an operated tractor rate of $40/hour, $1500 for fuel and maintenance, and $1500 for screener and spreader rental, the projected operating cost is $10,400 per year.

The original projections were to save $8,500 per year in rendering service fees and an additional $500 in avoided fertilizer costs for a total of $9,000. Based on the current projections for site operation, this would have resulted in an operating loss of $1500 per year. This figure did not take into consideration the undetermined fees for disposing of blood and other by-products that are being refused for rendering collection. Those materials most likely would have needed to be buried at a cost of at least $1200 per year, as the materials must be disposed of a weekly basis. This calculation makes the endeavor a nearly break-even operation in 1999 terms, at a $300 loss.

In April 2001, butcher shops and slaughterhouses were notified of increases in rendering service fees. Small butcher shop owners that attended the workshop described the increases being from 50% to 300% of their previous fee schedule. Depending on their location in NYS, rendering companies adjusted their rates to compensate for transportation costs and declining markets for the meat by-products.

For Mapleton Farms, per barrel fees would have increased to $45 per pickup, plus a per barrel fee. The annual fees would have increased to $14,820. Additional operating expenses for burying blood and non-accepted meat by-products would remain at least $1200. Therefore, 2001 disposal expenses are projected to have been $16,020.

The value of the composted materials was also underestimated at the time of the project proposal. The 100 tons (225 cy) of material that was applied represents a $3,375 value. Bulk compost prices range from $10 to $40/cy delivered to the farm. Conservatively applying a $15/cy value results in $3,375 worth of compost.

The total of avoided of disposal expenses and avoided costs for soil amendments equals $19,395 per year. Subtracting the projected $10,400 operating costs results in a net annual savings of $8,995 for the Mapleton Farms Country Butcher Shop.

Unexpected Results: The increasing expense of rendering service and the lack of available options for items such as blood, offal and sheep by-products made the project more attractive than originally anticipated. The reliability of on-site disposal provides unmeasurable benefits in reduced stress and anxiety. Other small butcher shops have scrambled to find disposal alternatives in light of the increasing fees and unknown future reliability of rendering services.

Task Eight: Plan and host workshop and tour. At least 15 potential composters attend.

Steps Taken: Working with Cornell Cooperative Extension of Cayuga County and Cayuga County Planning Department, the project team plus Bruce Natate, CCPD; and Dave Severson, AmeriCorps member; met to plan the format, presenters and other details of the workshop. Kelly Sevier developed a promotional flyer and brochure to publicize the event and distributed the announcement to statewide extension agents, conservation districts, media outlets, and selected agencies, related businesses and farms. The Gullivers prepared the site and barn to host the workshop and tour, provide tables of relevant information, a buffet lunch and a lunchtime speaker panel. Brian Jerose developed composting information sheets for attendees. See Appendices A and D.

Outcome: A workshop was conducted on Friday, April 27, 2001 with 70 attendees from around New York State. Speakers and panelists included the contractor and site owner/operators, Jeff and Darci Gulliver; Brian Jerose of Environmental Fertilization Corp, Jean Bonhotal of Cornell Waste Management Institute (CWMI), Kelly Sevier of Cornell Cooperation Extension of Cayuga County, Dave Wazenkewitz of the NYS Department of Environmental Conservation (DEC), Bruce Natale of CCPD, Ronda Sawyer of Fessenden Farms and Julie Patterson of Patterson Farms. Inspectors from the NYS Department of Agriculture and Markets (DA&M) also attended. A demonstration and tour of the meat scraps composting process was held before and after the lunch with a speaker panel to allow the attendees to view the operation. A question and answer session was held with the panel of speakers following each of their brief presentations.

Unexpected Results: The size and interest of attendees in the workshop was much greater than originally anticipated. The timing of the workshop was fortunate in that many butcher shop and slaughterhouse operators had received notice of rendering fee increases only a week prior to the workshop. At least ten operators stated that they would attempt composting trials with their slaughterhouse wastes following the workshop. Jean Bonhotal of CWMI currently estimates 10-12 other operations have started composting or are preparing to start composting since attending the workshop.

The discussions that arose during the workshop included the regulations surrounding the use of this practice on farms or on-site for other butcher shops and slaughterhouses. In general, local health department codes address the disposal of animal carcasses and wastes by stating nuisance conditions must be avoided. This leaves a great deal of room for subjective interpretation as practices among composters and the regulatory community for these types of wastes are not yet widely understood. From the NYS DA&M perspective, inspectors stated at the workshop that operations following practices and methods like those at the Mapleton Farms Country Butcher Shop would not be in violation of any requirements. From the perspective of the NYS DEC, on-site composting of materials was exempt from regulations. However, the regional engineer considered the importation of meat scraps from other operations to be a solid waste and not fall under the agricultural materials and food processing residuals exemption of 3,000 cubic yards per year. It is apparent that this matter needs clarification as more operations begin to compost meat by-products either on-site, on nearby farms or other compost sites.

IV. Summary of Learnings/ Next Steps

Summary of Major Findings: The Mapleton Farms Country Butcher Shop was capable of safely, effectively and affordably composting its butcher shop and slaughterhouse wastes. The contractor and project team successfully achieved all of the learning targets. The expectation of developing a model for other facilities was greatly exceeded. This was accomplished using existing and commonly available farm equipment and rental equipment. The site was suitable for composting approximately 120 tons of meat scraps and a total of 500 cubic yards of materials per year. Expansion beyond this scale would likely necessitate either an improved, impervious working surface or a formal rotation plan for the compost site in the present hay field.

The cost-savings realized by this project are $8,995 per year based on current rendering service fees, operating expenses and value of compost produced. This is discussed in III. Methodology; *Task Seven.* The economics are summarized in Table A. Projected Annual Cost Savings from Composting Meat By-Products.

Table A. Projected Annual Cost Savings from Composting Meat By-Products

Rendering Services Fees Savings	$14,820
Estimated Burial Expenses Savings	$1,200
Value of Applied Compost	$3,375
Compost Site Operating Expenses	-$10,400
NET SAVINGS	**$8,995**

The best operational procedures and material handling methods are outlined in a series of Composting Information Sheets and a Compost Site Operation and Maintenance Manual. See Appendix C. Briefly, the best approach to achieve nuisance-free composting is to incorporate meat scraps into actively composting materials and cover the outside of the windrow with a minimum of 12 inches of carbonaceous amendments such as leaves, woodchips and bedded horse manure. The volume ratio of materials should be approximately two parts carbon amendments to one part meat scraps. The C:N ratio should be 30:1 to 40:1 to aid in minimizing odors. The initial moisture content should be 63%. Covering the pile as meat scraps are exposed is critical to nuisance avoidance.

Conclusions: Composting is an effective meat by-products disposal strategy for those operations that have suitable sites, labor, equipment and carbon amendments available. Small butcher shops are most impacted by disposal fees but larger operations may face future challenges. Traditional rendering uses of meat scraps are likely more efficient in terms of recovering the multiple values of fats, blood, bones and other by-products. However, given the current economic situation with the rendering industry, composting provides one of the best available alternatives with respect to environmental and other concerns. Addressing this matter is critical for agricultural processing in NYS.

The project team predicts that this time of transition for the rendering industry will result in new uses being developed for various meat by-products. Applications in non-edible and industrial settings will avoid the real and perceived risks associated with BSE and other transmittable diseases. Utilization of animal fats in biodiesel fuel and biolubricants seems to hold potential considering both the current energy shortage and non-renewable nature of petroleum fuels and lubricants. Furthermore, animal fats is one of the most difficult components of meat by-products to effectively compost, it has traditionally been separated for tallow in butcher shops and could be readily source separated in the future should a new infrastructure develop.

The utilization of finished compost on-farm has multiple benefits. The certainty of a known disposal outlet for the meat scraps provides security in knowing expenses and meeting environmental requirements. The value the compost has as a soil amendment is both for the organic matter, nutrients and for the avoided cost of fertilizer inputs. Furthermore, the use of this compost allows for the future certification of the farm as organic, whereas chemical fertilizers and amendments are prohibited in organic farming.

Future Implementation Plans: Mapleton Farms Country Butcher Shop intends to keep composting its wastes at this time. The farm has secured additional carbon amendments to mix with meat scraps through the winter of 2001-2002 and the foreseeable future. The farm has made arrangements to maintain a tractor with a bucket loader and build windrows in a contiguous area to the original site.

The farm is now exploring the option of developing a larger integrated compost site on a separate portion of the farm property. This site may be capable of accepting meat by-products, food scraps, manure and other materials from local, regional and statewide points of generation. The project team intends to research funding opportunities, permitting requirements, local and business support and equipment for undertaking such a compost site development. The farm has been encouraged by officials on the county, state, and federal level to explore this type of compost site development.

Barriers: No significant barriers are projected for the continued operation of a compost site behind the hay barn adjacent to the butcher shop and slaughterhouse. The skill level of the operators has improved to the point where nuisance conditions are very unlikely to occur. Neighbors have expressed interest rather than objection to the site to date.

Several barriers are anticipated for the development of a larger compost site that would be capable of accepting outside meat by-products. Real and perceived risks associated with BSE and other diseases could make siting a facility difficult. Regulators issuing permits may hold this facility to an unreasonably high standard because of little precedent with large-scale composting of meat by-products in NYS. Area residents may object to a more centralized facility with potential for odors, increased traffic or other nuisance conditions. It is unclear what level of support or resistance will arise as the project team is only in the early stages of planning.

V. Bibliography

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