COMPOSTING FOOD WASTES AT THE 1999 SPECIAL OLYMPICS WORLD SUMMER GAMES

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INTRODUCTION

The 1999 Special Olympics World Summer Games were held in the Raleigh-Durham-Chapel Hill area of North Carolina from June 26 through July 4. This international event drew 7,000 athletes and 3,000 coaches from 150 countries to compete in 19 different sports. In addition, over 35,000 local area volunteers were recruited to help put the Games together and to provide a comprehensive support program for the athletes, coaches, and families.

In mid-1998, representatives of the Special Olympics Games Organizing Committee (GOC) requested a meeting with local area solid waste and recycling professionals to discuss the logistics of solid waste management at the Games. Over the course of the following year, three separate committees of professionals were assembled, one each for solid waste disposal, for recycling, and for food discards composting.

PLANNING PROCESS

The Composting Subcommittee met monthly from January 1999 until June 1999. The subcommittee prepared an operations plan for composting during the Games. The operations plan spelled out the logistical details of food discards collection, transportation, composting, and compost use. Financial support for the program was obtained from the Division of Pollution Prevention and Environmental Assistance (DPPEA) in the North Carolina Department of Environment and Natural Resources (DENR).

Project planning included detailed evaluations of the Special Olympics plans for feeding visiting athletes and coaches, selection of the collection containers to be used for food discards collection, preparation of signage for containers and obtaining Solid Waste Composting Demonstration Permits from the Division of Waste Management, NCDENR. This planning process also included developing a "flow plan" for food discards. This plan addressed the questions of what to divert, how to divert it, the roles of volunteers, the placement of the collection containers, the movement of the containers from the kitchens to the composting sites, the unloading and mixing procedures at the composting sites, and other factors.

PROJECT IMPLEMENTATION

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During the Summer Games, Olympians were housed at three area universities (North Carolina State University (NCSU) and Meredith College (in Raleigh) and University of North Carolina (UNC) at Chapel Hill). The athletes, coaches, staff, and volunteers used the universities' dining halls for their meals.

154,369 meals were served from 5 AM to Midnight from June 24 through July 5, 1999. The number of meals served daily was much greater than the normal school-year number of meals served at NCSU (10,000 per day as opposed to 4,500 per day during the school year). The number of meals served at Meredith and UNC were similar to normal servings. The Special Olympics established menus in advance, and food service was all-you-could-eat buffet style with disposable paper plates, cups, and cutlery.

A pool of 62 volunteers was assembled to accomplish this food discards diversion. Volunteers were drawn from state government, local recycling associations, and local high school environmental clubs. Volunteers were assigned to one or more of the three dining halls and were organized into 3-hour shifts, a lunch shift from 11:30 – 2:30 and a dinner shift from 5:30 – 8:30. Breakfast and late dinners were not included in the project at NCSU, due to logistical constraints with the dining halls and a lack of adequate numbers of volunteers. These other meals were captured at Meredith and UNC as the kitchen staff helped with the diversion.

FOOD WASTES COLLECTION

Separation of compostable food wastes from non-compostable items was accomplished at diversion stations established in the proximity of tray-return areas and dishwashing rooms. Volunteers and dining hall personnel staffed these stations.

Food discards were collected in 40-gal. wheeled Zarn containers (lined with 45-gal. 100% recycled black plastic bags). These containers were labeled with the Special Olympics recycling logo and a food waste-to-compost graphic illustration. The disposable products used by the dining halls contained both poly-coated and non-coated plates and bowls; the cutlery was all plastic. Some small paper plates were included in compostables (Chinette brand of non-coated paper plates); but most were not taken due to wax/poly coatings. Larger dinner plates (Chinette 9 ¼" dinner plates) were taken at first, but later not included due to their effect on compost mix C/N ratios, their effect on mix moisture content, and the potential to blow around on site. Compostables also included paper napkins.

Full containers were transported to two compost sites (one at NCSU and one near UNC-CH) in 15- ft. box trucks equipped with hydraulic lift gates. For the NCSU compost site, the truck was weighed after each meal using MD-500 portable truck scales (capacity of 20,000 lbs). For the UNC compost site, individual containers were weighed using a Pelouze heavy-duty postal scale (400 lb capacity). The total amount of food discards transported to the NCSU site was 13,888 pounds; the amount diverted to the UNC compost site was 7,736 pounds, for a total diversion of 21,624 pounds (10.8 tons). Table 1 lists the weights by day for each site.

Table 1

Date	MEALS SERVED	FOOD DISCARDS (LBS) NCSU/Meredith	COLLECTED UNC – CH	Total
6/24/99	2,340	430	389	819
6/25/99	14,405	1768	488	2256
6/26/99	16,772	815	353	1168
6/27/99	16,614	1630	549	2179
6/28/99	17,885	1768	1271	3039
6/29/99	17,147	1380	950	2330
6/30/99	17,605	1780	865	2645
7/1/99	17,504	1556	917	2473
7/2/99	17,876	1493	914	2407
7/3/99	16,221	1268	1040	2308
Totals	**154,369**	**13888**	**7736**	**21624**

COMPOSTING AT THE NCSU SITE

The site is normally used to produce mulches from campus and municipal yard waste. The compost mix at the NCSU site consisted of food discards, partially composted leaf mulch from 1997 leaf fall, and ground, screened wood waste from campus landscaping (screened to a 1" minus mesh size). Figure 1 illustrates the nature of the waste stream.

Figure 1

The bulking agent (leaf mulch and wood waste) was added to the food waste at approximately a 5:1 volumetric ratio. This ratio is larger than the typical value used in composting (3:1) because North Carolina regulators required the windrows to be recovered

after each turning to conceal exposed food wastes. As finished compost was not available to cover the windrows, additional wood waste or leaf mulch was used.

Wastes from each meal were dropped off on 6" wood mulch base, debagged, spread evenly (contaminants removed), and covered with 6" layer of leaf mulch. Approximately 200 gallons of water were added after each layer (food wastes & leaf mulch). Four meals (four layers) were added to the mixing pad over two days. Materials were mixed with a Wildcat Model FX 700 PTO Turner (pulled by Ford 9030 Tractor). Mixed materials were reformed into a windrow on 6" layer of wood mulch with Ford 755A Backhoe Loader. Windrows were covered with 3-4" layer of wood mulch (1"- ground and screened wood waste).

Three windrows were constructed over the course of twelve days. As composting progressed over the next several weeks, the windrows were combined into one longer windrow. The total quantities of materials used in the compost mix are shown in Table 2:

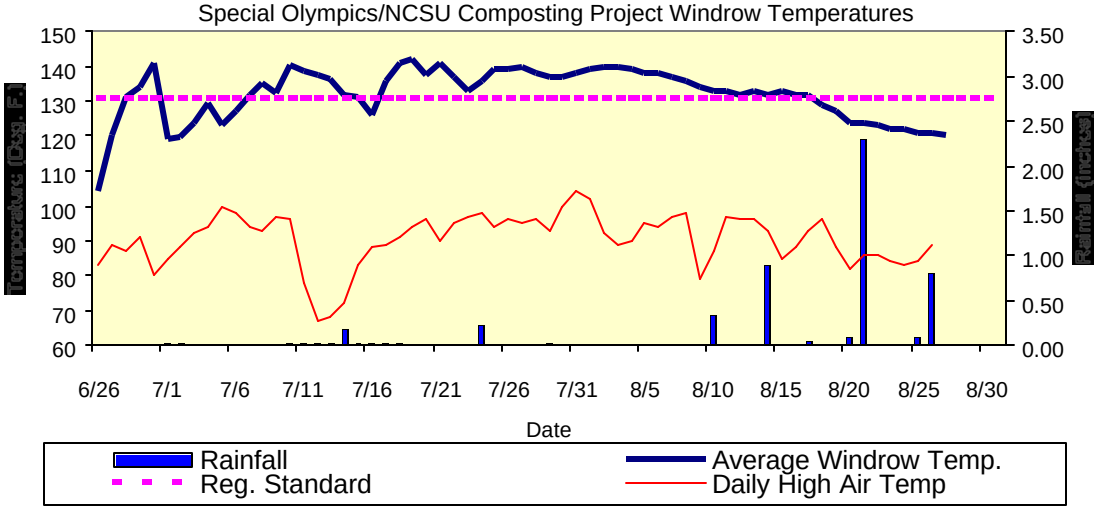
Table 2
Compost Mix Materials (cubic yards)

Ingredient	Windrow #1	Windrow #2	Windrow #3	Total
Food Wastes*	5.2	7.2	3.1	15.5
Leaf Mulch	10.5	10.5	7.5	28.5
Wood Wastes	19	20.5	9.0	48.5
Water (gallons)	1,750	2,520	1,020	5,290

*Food waste bulk density assumed to be 900 lbs/cubic yard

Windrows #1 and #2 were turned six times between June 26 and July 21 before being consolidated together. Windrow #3 was turned five times before consolidation. Consolidation was needed to more effectively utilize the windrow turner. The consolidated windrow was turned an additional five times between July 21 and August 20. Water was added periodically if the compost mix in the windrows did not pass the "squeeze test". Composting temperatures at the NCSU site exceeded the regulatory requirement of a minimum temperature of 131^{o} F. for 15 days. Figure 2 shows the average windrow temperatures at the NCSU site as well as daily high air temperatures and rainfall recorded at a nearby weather station. Unusually cold temperatures around July 12 significantly affected compost pile temperatures; however temperatures rebounded over the next several days to ensure meeting Process To Further Reduce Pathogens (PFRP) requirements.

Figure 2
Special Olympics/NCSU Composting Project Windrow Temperatures



COMPOSTING AT ORANGE COUNTY SITE

The Orange County composting site is located at the Orange County Regional Landfill in Chapel Hill. The site was approximately 4,000 s.f. (40x100) and fenced to prevent windblown litter from entering or leaving the site.

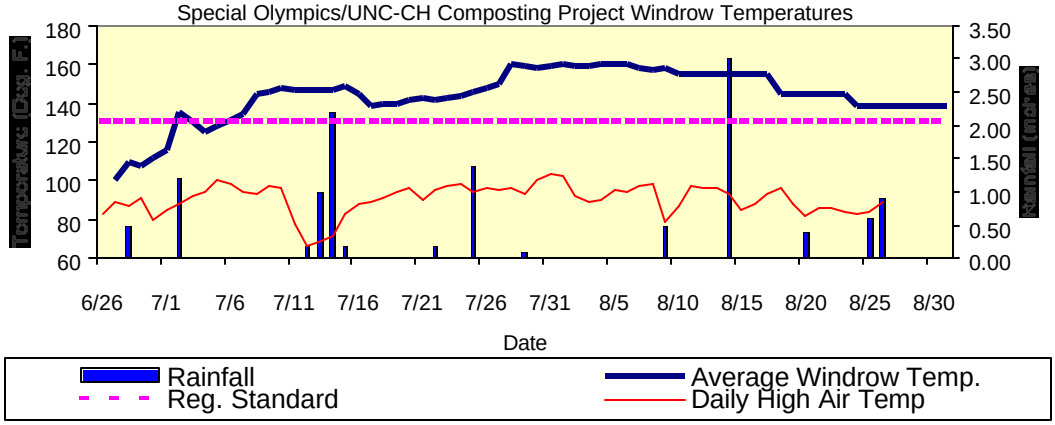
Food wastes were removed from bags, spread out on a 6" base of ground yard waste supplied by the Town of Chapel Hill, and inspected for contaminants. Because paper plates and cups used at Lenoir Dining Hall were plastic coated (hence not fully biodegradable), they were not included in the diversion program. Another significant difference in the composition of food discards from Lenoir Dining Hall is attributed to the inclusion of unserved food from the serving lines and food preparation areas.

After contaminant removal (mostly plastic cutlery), the food discards were mixed with the ground yard waste base using a Bobcat 863 bucket loader and formed into a pile. The yard waste bulking agent was added to the food discards at a volumetric ratio of approximately 2.5 to 1. A total of 3 piles were built over the course of the Summer Games. Each pile was approximately 8-9' wide, 14' long, and 3-3.5' high. Following the attainment of the regulatory requirement for minimum temperatures, the piles were combined. Figure 3 depicts the nature of the food discards collected at Lenoir.

Figure 3

Composting temperatures at the Chapel Hill site also exceeded the regulatory requirement of a minimum temperature of 131° F. for 15 days. Figure 4 shows the average windrow temperatures at the Chapel Hill site as well as daily high air temperatures and rainfall recorded at a nearby weather station. The July 12 cold spell had less effect on these compost piles as they were configured as static piles, with greater insulation characteristics.

Figure 4
Special Olympics/UNC-CH Composting Project Windrow Temperatures



COMPOST ANALYSIS

The compost piles completed the active composting phase by the end of August. The composts were allowed to cure until the end of November. Composts were sampled and analyzed in accordance with the requirements of the North Carolina Solid Waste Compost Rules[3].

Testing for foreign matter content was accomplished by drying the samples (EPA Method 160.3), weighing samples, and screening samples through a 0.25 inch screen. No foreign matter was detected in either sample. Samples were partitioned and sent to three laboratories

[3] NC Division of Waste Management, North Carolina Solid Waste Compost Rules, 15A NCAC 13B, Section .1408(a) – (d)

for analysis: North Carolina Dept. of Agriculture Agronomic Division for nutrients, heavy metals, soil testing, and Mehlich-3 Extraction for soil heavy metals; Woods End laboratory for pathogen analysis, and Soil FoodWeb, Inc. for microbiological analysis. Analytical results are shown in Tables 3 through 6.

Table 3
Waste Analysis Report

Parameter	NCSU	UNC	Reg. Criteria
Chemical Constituents			
(ppm, unless noted)			
Total Nitrogen	7484	7015	
Phosphorus	594	925	
Potassium	1356	2156	
Calcium	7299	7301	
Magnesium	866	5888	
Sulphur	550	792	
Iron	9160	22473	
Manganese	337	659	
Zinc	51.5	55.7	2800
Copper	12.0	63.4	1500
Boron	28.8	52.8	
Carbon	122385	82578	
Sodium	433	854	
Nickel	2.03	10.3	420
Cadmium	0.81	1.51	39
Lead	9.81	3.11	300
pH (units)	6.42	6.93	
Soluble salts	68.0	111.0	
C:N Ratio	16.35	11.77	
Dry Matter %	55.02	57.08	

Table 4
Soil Test Report

Parameter	NCSU	UNC
Soil Class	Mineral	Mineral
Humic Matter (%)	0.6	0.43
Weight/Volume Ratio (gm/cm^3)	0.56	0.73
Cation Exchange Capacity ($meq/100cm^3$)	16.3	18.8
Base Saturation (%)	93.0	100.0
Exchangeable Acidity ($meq/100cm^3$)	1.1	0.0
PH	6.7	7.0
Phosphorus Index	34-Medium	95- High
Potassium Index	282- Very High	111- Very High

Calcium (%)	69.0	79.0
Magnesium (%)	16.0	18.0
Manganese Index	92- High	504 -Very High
Zinc Index	317 - Very High	241 - Very High
Zinc Availability Index	317	241
Copper Index	46	164
Sulphur Index	39	211
Sodium (meq/100cm^3)	0.7	1.8

Table 5
Pathogen Analysis

Parameter	NCSU	UNC
Pathogens - Salmonella	< 1.6 MPN/100 g	< 1.4 MPN/100 g
Pathogens - Fecal Coliform	< 4 MPN/100 g	< 120 MPN/100 g

Table 6
Soil Foodweb Analyses

Parameter	NCSU	UNC	NOTES
Organism Biomass Data			
Dry weight (one gram)	0.51	0.6	
Active Bacterial Biomass (ug/g)	8.3	13.4	Desired range: 20-50
Total Bacterial Biomass (ug/g)	287	207	Desired range: 200-600
Active Fungal Biomass ug/g)	42.1	79.5	Desired range: 20-30
Total Fungal Biomass (ug/g)	107	111	Desired range: 100-300
Hyphal Diameter (micrometers)	2.5	2.5	
Protozoa (#/gm)			
Flagellates	8966	9588	Desired range: 10,000+
Amoebae	11201	46201	Desired range: 10,000+
Ciliates	271	768	Desired range: 200-500
Total Nematodes (#/gm)	33	10.9	Desired range: 20-30
Organism Ratios			
Total Fungal : Total Bacterial Biomass	0.37	0.54	*see below for
Active to Total Fungal Biomass	0.39	0.72	Interpretation of
Active to Total Bacterial Biomass	0.03	0.06	these results
Active Fungal : Active Bacterial Biomass	5.07	5.09	
Plant Available N Supply from Predators (lbs/acre)	200-250	250-300	
Root-Feeding Nematode Presence	None detected	None detected	

INTERPRETATION OF FOODWEB ANALYSIS

Samples of both composts were submitted to Soil Foodweb, Inc. for an analysis of their microbial activity. Not a required testing parameter, the foodweb analysis is an emerging technique that assesses the diversity of microorganisms in compost as an indicator of overall quality and maturity. Active bacterial and active fungal biomass indicate the activity level of these organisms present in the compost, suggesting degree of maturity. Generally, activity above 0.10 indicates immature piles, as long as heating cycle has been achieved. In these 2 composts, the bacterial activity was at the desired level for mature compost (0.03 for NCSU and 0.06 for UNC). Both composts had more active fungi than active bacteria, however, suggesting the compost was in the maturation phase but not yet stable (0.39 for NCSU and 0.72 for UNC). Both composts were more bacterial than fungal, indicating they would be most suitable for application to row crops and grasses, whereas if the composts were more fungal than bacterial, they would be more suitable for berries, shrubs, or trees. The composts both possess good nutrient cycling and lots of plant-available Nitrogen, based on the numbers and diversity of predator organisms. Although there were no root-feeding nematodes found in either compost, the numbers and diversity of other nematodes was lower than desirable.

COMPOST UTILIZATION

Finished compost from the project was used in local planting projects. In Raleigh, the NCSU compost was used at NCSU's J.C. Raulston Arboretum and around the Bell Tower on central campus. The UNC compost was used by the Town of Chapel Hill for new planting beds at its Community Center, in Durham at S.E.E.D.S. community garden, and at North Chatham Elementary School in its educational gardening curriculum.

PROJECT ANALYSIS

Implementation of this food discards diversion and composting project required coordination with a large number of people, organizations, and governments. As with any waste management project, there were several areas where implementation was successful and several areas where improvements could be made.

The 40-gal. Zarn carts with recycled-content plastic bag liners were an effective means of moving food discards through crowded dining halls during the Games. Using volunteers and training dining hall staff to control separation of food discards at diversion stations greatly reduced the contamination with non-compostables. The use of 15-foot box trucks with lift gates were an efficient means of transportation for filled food discard containers, but smaller trucks could have served the purpose as well. No incidents of spillage or leakage were reported.

At both composting sites, the composting process worked extremely well, with no problems reported with vectors or vermin, nor with odors. The composting mix recipes used, while different at the two sites, were successful in raising composting temperatures to the

thermophilic range quickly, and both sites met the regulatory requirements for pathogen destruction.

PROJECT COSTS/BENEFITS

Project costs for food discards composting include costs incurred by the GOC and costs incurred by outside sponsoring and cooperating organizations. Data is only available for those costs incurred by the North Carolina Division of Pollution Prevention and Environmental Assistance:

Subcontractor services	$ 16,140.00
Food discard collection carts	2,263.73
Labels for containers, signage	4,189.12*
Container liners	396.71
Brochure color copies	742.00
Volunteer buttons	121.90
Compost testing (estimate)	500.00
Total composting project costs	$ 24,353.46

*(includes recycling bins for plastics, paper, and aluminum)

These costs also do not include the "labor costs" of the volunteer pool working on the composting project. The 62 volunteers working on the project invested about 900 person-hours of time. With sufficient lead time and planning, the costs for labeling and signage can be greatly reduced (the costs shown above reflect rush charges to meet rigid deadlines). The brochures to educate athletes, coaches, and delegation assistants could be done without incurring color photocopying charges. The above costs also do not reflect the actual cost of composting equipment, except what is included in subcontractor services for the UNC-CH site. The cost of composting equipment at the NCSU site was absorbed by the existing operation.

The costs for composting food discards at the Special Olympics were extremely high relative to normal costs for food discards composting. The major reason for this was due to the lack of a food discards composting infrastructure in North Carolina. Had there been an existing facility that could have taken these special event wastes in addition to normally-diverted food discards, the operational and capital costs would have been much lower.

In North Carolina and beyond, this project set an important environmental management precedent. Benefits of the project go beyond the successful diversion of nearly 11 tons of food discards from North Carolina landfills. Perhaps the most important benefit is the institutional knowledge of food discards composting gained by the Games Organizing Committee and the hosting universities. This acquired knowledge, including identification of barriers to composting at major international athletic events, enables Special Olympics and other organizers to pursue composting at future events with a higher level of confidence and efficiency.