Community Food Systems Team

UW-Cooperative Extension Just in Time Webinar Program

Wednesday, July 24th - 1:00-2:00 PM
**Food Waste Management: A Primer, Part 1**

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Food Waste/Waste Management
A Primer - Part I

Jonathan Rivin
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Disappearing Food

- Food disappearance worldwide
- 4 billion metric tons/yr produced
- 30%-50% food lost before consumption
- 1.2-2 Billion metric tons/yr lost
Disappearing Food

- Consumption waste
- $\sim \frac{1}{3}$ in developed countries
- $\sim 10X$ that in developing countries
Disappearing Food

- Food (edible) loss
  - Production, harvesting, handling, transportation, processing, storage (FAO)
  - Any loss post harvest (USDA)

- Food (edible) waste
  - Distribution (vendor), storage, handling, preparation, consumption → garbage
Why Worry about Disappearing Food?

Nutrients

50 million people food insecure in US

Reducing food waste 15% (US), feed 25 million
Why Worry about Disappearing Food?

Resources

- 7.3 units of energy (primarily fossil) consumed for every unit of energy produced.
Why Worry about Disappearing Food?

Resources

50 glasses water = oranges for 1 glass orange juice

500 million hectares globally used to produce food not consumed [by humans] (2005)
Why Worry about Disappearing Food?

Economy

133 billion lbs of food waste (retail, restaurants, homes) = $161 billion

Cost (tipping fees) for disposing food waste in landfills => $2 billion

$282 million of uneaten turkey tossed on Thanksgiving (2012)

Per capital food expenditures = $4,229 (2011)
Why Worry about Disappearing Food?

Environment

Reduces lifespan of landfills (NIMBY)

1.1 b lbs pesticides (US); 80% in agriculture (2007)

83% of average US household carbon footprint/yr for food consumption is agricultural production
Global Food Demand

- Global population @ 9.1 billion in 2050
- Food production increase ~70% to meet demand
- Worldwide meat consumption: 40% increase by 2050
Global Food Demand

- Meeting demand
- 170 m more acres needed by 2050
- 80% increase in crop yields in developing countries
Global Food Demand

- Meeting demand
- Shifting food for animals to human consumption, food production increase about 50%
- 1 ht rice/potatoes = 19-22 people/yr
- 1 ht lamb/beef = 1-2 people/yr
Global Food Demand
Food or Fuel?

Syngenta .......[marketing their].....Enogen® corn
which features
the first biotech output trait designed for ethanol production.
Global Food Demand

Estimates Do Not Assume Any Reductions in Food Wastage
2011 MSW Generation
> 250 million tons before recycling

- Food waste: 14.5% (36 m tons)
- Paper & paperboard: 28.0%
- Yard trimmings: 13.5%
- Plastics: 12.7%
- Metals: 8.8%
- Glass: 4.6%
- Rubber, leather & textiles: 8.2%
- Wood: 6.4%
- Other: 3.3%

Food Waste
- 4% recycling rate
- WI (2009): 455k t (11% MSW)
Assessment:
Total Food Waste DISPOSED by Sector

US Food Waste Disposal Data

- Grocery Stores: 11%
- Full Service Restaurants: 20%
- Quick Service Restaurants: 13%
- Institutional: 10%
- Residential: 44% - 47%
- Industrial: 2%

\[ \approx \frac{1}{3} \text{ food purchased, not eaten} \]
Consumer Food Waste

- North America/EU: 95-115 kg/person/yr (254 lb/p/yr)
- Households (US)
  - 2/3 spoilage
  - 1/3 cooking/serving too much
Household Food Waste Generation

Figures within bar state waste in millions of tonnes per year

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Avoidable food waste</td>
<td>Food that is thrown away that was, at some point prior to disposal, edible (e.g. slices of bread, apples, meat)</td>
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<tr>
<td>Possibly avoidable food waste</td>
<td>Food that some people eat and others do not (e.g. bread crusts, potato skins)</td>
</tr>
<tr>
<td>Unavoidable food waste</td>
<td>Waste arising from food preparation that is not, and has not, been edible under normal circumstances (e.g. bones, egg shells, pineapple skins)</td>
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Source: based on WRAP (2009) *Household Food and Drink Waste in the UK*

Source: European Commission. 2010. Preparatory Food Waste Study Across EU 27
Food Waste Recovery Hierarchy

**Source Reduction**
Reduce the volume of food waste generated

**Feed Hungry People**
Donate extra food to food banks, soup kitchens and shelters

**Feed Animals**
Divert food scraps to animal feed

**Industrial Uses**
Provide waste oils for rendering and fuel conversion; food wastes for digestion to recover energy; incineration

**Composting**
Create a nutrient-rich soil amendment

**Landfill**
Last resort for disposal

Food Waste Disposal
The portion of food waste that is sent to landfill or incineration
“The most important problem in the future will be to tackle increased demand for food, as it will outstrip supply. We can no longer afford to stand idly by, while perfectly edible food is being wasted. This is an ethical, but also an economic and social problem, with huge implications for the environment.”

European Parliament (January 2012)
* Food Waste Resources

Sources, Collection & Traditional Disposal Options
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Director-Marathon County Solid Waste Department
President-Associated Recyclers of WI
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What do we think of when we say “waste”?

* Yuk factor

* Worthless factor

* Missed opportunity factor
*What do we think of when we say the word “resource”?
  * Wow factor
  * Value factor
  * Opportunity factor

*Framing a Change With The Right Words
* Farm fields
* Transportation
* Wholesale & retail
* Manufacturing
* Commercial
  * Restaurants, cafeterias, events, institutions
* Households

*Sources of Food Waste Resources*
Today in Wisconsin
* Retail, Commercial & Institutional
  * Both pre-consumer & post-consumer go to either dumpster (mixed with other waste) or drain garbage disposal
  * Some are diverting some fruit/vegetable materials to compost, farms (feed hogs) & digesters
    * Orchard Ridge Landfill food waste composting project
      * Milwaukee-area grocers send fruit/vegetable waste for composting
    * Wal-Mart
      * Strategic goal to divert organics (including food waste resources) to food donation, composting or waste-to-energy

* Collecting Food Waste Resources
* Households
  * Two or three bins for refuse - none for food waste collection
    * Madison & Fitchburg
      * 2012/2013 pilot
    * Backyard composting

* Collecting Food Waste Resources
* Today’s most common disposal option (in the U.S.)
  * Sanitary Landfills
      * Locational criteria
      * Clay liners
      * Plastic (geo-membranes) liner
      * Leachate collection system
      * Active gas collection system
      * Closure requirements
      * Financial responsibility requirements
      * Environmental monitoring requirements
**Creating A Cell**
Each day trash is placed, compacted, and converted into a compacted layer of soil. This pocket of waste is called a cell.

**Old Cells**
By compacting and covering the waste in cell-by-cell, the formation of methane gas and leachate is reduced.

**Leachate Disposal**
This collected leachate is either disposed of on-site or used for on-site dust control.

**Leachate Collection Pipe**
Leachate drains into pipes where it is pumped into holding ponds or tanks.

**Soil Layer**
A 30-inch layer of soil placed over the gravel and the gravel drainage layer.

**Textile Mat**
The mat and a liner are anchored inside the coven environment.

**Granular Drainage Layer**
Gravel and rock are added to allow water to leak through the layer.

**Washed Rock**
Leachate percolates through the layer of washed gravel.

**Groundwater**
Leachate is monitored for potential contamination.

**Leachate Percolation**
Leachate runs through the gravel and rock layer into pipes located at the bottom of the landfill.

**Geotextile Mat**
A nonwoven fabric mat protects the plastic landfill liner from the gravel in the washed rock layer.

**Soil Layer**
A 30-inch layer of soil placed over the gravel and the granular drainage layer.

**Compacted Clay**
Compacted clay separates a landfill from groundwater. It can also meet permanently stable benchmarks may be added to the soil to create this dense layer of clay.

**Leachate Percolation**
Leachate runs through the gravel and rock layer into pipes located at the bottom of the landfill.

**Landfill Slopes**
The slope of a landfill may be lined with a geosynthetic nonwoven fabric mat and polyethylene liner. The mat and a liner are anchored inside the coven environment.

**Liner Seams**
Sections of the plastic landfill liner are bonded together by heat welding. Seams are tested while the landfill is in use or strength and permeability.

**Plastic Liner**
The polyethylene liner is designed to prevent leachate from draining into the groundwater.

**Site Analysis**
A study must be made of an area before it can be approved as a landfill site. This analysis considers the wildlife living in the area, as well as the condition of the underlying soil and bedrock. It must also be determined if the site has historical or archeological value.

**Landfill Gas Disposal**
The collected gas is disposed of either by thermal destruction or flaring and converted to electricity in a gas utilization facility.

**Landfill Gas Condensate Disposal**
The collected gas condensate is collected in storage tanks and housed off-site for treatment or routed to the flares and disposed.

**Buffer Area**
Each day trash is placed, compacted, and converted into a compacted layer of soil. This pocket of waste is called a cell.

**Old Cells**
By compacting and covering the waste in cell-by-cell, the formation of methane gas and leachate is reduced.

**Leachate Percolation**
Leachate runs through the gravel and rock layer into pipes located at the bottom of the landfill.

**Geotextile Mat**
A nonwoven fabric mat protects the plastic landfill liner from the gravel in the washed rock layer.

**Washed Rock**
Leachate percolates through the layer of washed gravel.

**Granular Drainage Layer**
Gravel and rock are added to allow water to leak through the layer.

**Groundwater**
Leachate is monitored for potential contamination.
* 455,259 ton of food waste entering WI landfills
* Approximately 11% of overall tonnage
* Not a large portion of the waste stream, but is responsible for most of the issues at landfills
  * Leachate management
  * Gas system management
  * Environmental monitoring

* 2009 WI State-Wide Waste Characterization Study
C\textsubscript{10}H\textsubscript{20}O\textsubscript{6}N\textsubscript{2} + 3H\textsubscript{2}O \rightarrow 5.5 \text{CH}_4 + 4.5 \text{CO}_2 + 2\text{NH}_3

C\textsubscript{n}H\textsubscript{n-2}O\textsubscript{n-1} + nH\textsubscript{2}O \rightarrow \frac{1}{2} n\text{CH}_4 + \frac{1}{2} n\text{CO}_2

C\textsubscript{54}H\textsubscript{106}O\textsubscript{6} + 28 \text{H}_2\text{O} \rightarrow 40 \text{CH}_4 + 17 \text{CO}_2

* Anaerobic Decomposition

WE'LL TELL YOU WHERE TO PUT IT.
* All liquid (including precipitation) coming in contact with waste must be treated as leachate
  * As liquid percolates through waste mass, picks up volatile organic compounds, toxins & metals
    * Lead, mercury, benzene, trichloroethylene, pharmaceuticals, etc.
      * Not all compounds are removed in WW treatment systems
* Leachate sent to wastewater treatment plants
  * Transport is expensive
  * Treatment is expensive
  * Penalties for excessive suspended solids (SS)
  * Penalties for excessive biological oxygen demand (BOD)
* Some WWTP will not take leachate
  * One WI landfill shipped leachate nearly 125 miles
Gas system efficiencies

Estimates range from 60%-80% efficient at capturing landfill gasses

2012 gas production at MCSW landfills = 413,855,759.41 SCFM @ 51% methane

Fugitive emissions

Cover materials

EPA Air permit requirements
* Real costs related to managing landfill gas system
  * Staff
    * MCSWD - 1 FTE dedicated to gas system management
  * Gas & condensate system infrastructure
    * Installation of 1 gas well = $8,000-$10,000
    * Hundreds of thousands in connecting piping (header pipes)
  * Host community compensation
    * Odors are generally a dis-amenity for which landfills neighbors are compensated
  * Air permit
    * $5,000-$20,000 every 5 years
    * Non-compliance costs = $20,000+ per day

*Gas system management*
* Environmental monitoring occurs during active phase of landfill and for 40 years after closure
  * Groundwater monitoring
  * Potable well monitoring
  * Gas migration monitoring
  * Air quality monitoring
  * Compliance costs related to exceedances
* Any new or expanded landfill after 2005-required to have organic stability plan
  * Must bring landfill into a stable state...
    * A point at which there is no need for engineering/maintenance to manage environmental impacts caused by decomposing organic materials
  * Most plans include leachate recirculation
    * Obtain maximum saturation level for waste to ensure rapid decomposition
    * Use biologics in leachate to enhance decomposition
    * Many operational issues
    * Extra costs
  * To a lesser degree - organics diversions
    * Could play a bigger role in the future

* NR 514.07 Organic Stability Plans
Competition for the organic fraction of the waste stream

- Despite problems caused by food in landfills, landfill-gas-to-energy (electricity, heat & biogas) require organics in landfills
- Compost operations
- Anaerobic digesters
- Feedlots

But ...........
*What is the “best” means of managing food waste resources?

Source Reduction
Additional Resources
UWEX Community Food Systems Team blog- http://fyi.uwex.edu/cfsi/

An archive of this presentation can be found on the blog listed above with the following supplemental documents:


*Gustavsson et al., 2011. Global Food Losses and Food Waste. FAO.

(UWEX Colleagues) Just in Time Webinar Program registration can be found on the CFS Team blog.
THANK YOU!