Benefits associated with local use of treated fecal material

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Each year - per person

- 700 kg
- 94% Water
- 2.2 kg C
- 3 kg N
- 0.7 kg P and K

- 36.5-90 kg
- 75% Water
- 4.4-11 kg C
- 1-2.5 kg N
- 1 kg P and K
First mission

• Protect public health
  – This discussion based on the assumption that treatment is available to kill pathogens
Value and options

• Urine
  – Fertilizer value clear

• Feces
  – Fertilizer value
  – Carbon value
    • As fuel
    • To enrich soil
Energy value
(Brown et al., 2010)

• With solar drying 1 kg dry feces = 1 kg coal
  – Savings of 2 kg CO$_2$ per kg
  – However, high N in feces = high N$_2$O emissions
  – These can be up to 1.5 kg CO$_2$e per kg

• Without solar drying 75% water means burning requires energy = no benefit
Soil Value
(Brown et al., 2010, 2011)

• 1 kg dry also = GHG credits
  – Soil carbon = 0.37 kg CO$_2$
  – Fertilizer avoidance
    • Nitrogen = 0.3-0.4 kg CO$_2$
    • Phosphorus = 0.1 kg CO$_2$
1 ton compost
3.23 versus -0.38

Brown et al., 2010
Secondary benefits
(Brown and Cotton, 2010; Brown et al., 2011)

• Adding organic matter to soil:
  – Improves soil water holding capacity and water infiltration
  – Improves soil fertility- long term
  – Increases soil microbial community- reducing potential for disease
  – Often increases yields
Urban/peri-urban agriculture
• Cities are growing across the globe
• Not all characterized by single family homes with yards
• Newer, high density cities agriculture in perimeter
• More recent knowledge of agriculture
Benefit: Increased food security/ economic security

### Dryland wheat

<table>
<thead>
<tr>
<th></th>
<th>Carbon</th>
<th>Nitrogen</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mg ha</td>
<td>%</td>
<td>1 bar</td>
</tr>
<tr>
<td>Control</td>
<td>17.33</td>
<td>0.08</td>
<td>0.09</td>
</tr>
<tr>
<td>Biosolids</td>
<td>25.6</td>
<td>0.13</td>
<td>0.1</td>
</tr>
<tr>
<td>% Change</td>
<td>48</td>
<td>63</td>
<td>11</td>
</tr>
</tbody>
</table>
Wheat

- Yield in lbs per acre
  - 60 lbs = 1 bushel
  - $8 per bushel
Yield- predicted and actual

• WSU model based on soil water
  – Increase predicted at 10-20%
• Observed in last 2 of 3 harvests at >25%
What increase means:

- Increased revenue
  - Per ha $1500 versus $1200
Benefit: Reduces availability of contaminants in soils
Attanayake et al., 2014
Reduced Pb availability for soil ingestion (33-48%)
City of the future

• Wastes to soil
  — To protect soil health
    • Improved soil quality
    • Reduced metal loadings
  — To protect public health
    • Success in urban- peri urban agriculture
    • Associated food security
    • Economic security
Benefit: Improved diets