Introduction
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HEALTH ASPECTS OF SANITATION LINKED TO AGRICULTURE
What are the risks?

Helminthes (worms)

- Shigella (bacteria)
  - Wikipedia.org
  - k-state.edu

entamoeba histolytica (protozoa)

- Entamoeba histolytica
  - ktvz.com

Enterovirus D68

- CDC
  - http://www.dpd.cdc.gov/dpdx
"You are what you eat?!"
Disturbing?

Faeces

Sanitation

Agriculture

manure, fertilizer & fertigation

Fruits, vegetables & staple food
Factors influencing pathogen survival

- UV-radiation
- pH
- Antagonists
- Plant surface
- Soil
- Moisture
- Temperature

°C
Survival of pathogens in different environments

- **Viruses**
  - Fresh water and sewage max
  - Crops max
  - Soil max

- **Bacteria**
  - Fresh water and sewage max
  - Crops max
  - Soil max

- **Protozoa**
  - Usually
  - Usually
  - Usually

- **Helminthes**
  - Usually
  - Usually
  - Usually

WHO (2006)
Barriers

- Farmers
  - treatment
  - awareness
gloves   drip/furrow irrigation
boots/   tools   health care
footwash
handwashing

- nearby communities
  - no sprinkler
  - take care of children

- consumers
  - cooking
  - peeling
crop restrictions
handwashing
Effectivity of safety measures

Pathogen reduction (log)

- Produce cooking: 6
- Produce peeling: 2
- Produce desinfection: 2
- Produce washing with water: 1
- Spray buffer zone: 1
- Spray drift control: 1
- High growing crops: 2
- Localized (drip) irrigation: 2
- Wastewater treatment (max): 6
- Wastewater treatment (min): 1

WHO (2006)
## Log reduction (= comma shift)

<table>
<thead>
<tr>
<th>Pathogen / indicator organism</th>
<th>Log reduction primary treatment</th>
<th>Log reduction secondary treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Coli</td>
<td>1.7</td>
<td>1.7</td>
</tr>
<tr>
<td>S. Senftenberg</td>
<td>2.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Clamylobacter jejuni</td>
<td>0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

*anaerobic digestion*

!! die-off was a function of the numbers of pathogens in the feed, as these increased the log removal also increased !!

*Horana et al. (2004)*
WHO Guidelines – have fun…

2.4 Tolerable risk
The management of risk is context specific; there is no universally applicable risk management formula. In setting guidelines for waste-fed aquaculture, it would be logical to ensure that the overall levels of health protection were comparable with those for other water and excreta exposures (e.g. through drinking-water or recreational water contact and through inadequate sanitation). This would require comparison of very different adverse health outcomes, such as cancer, diarrhoea, etc. Significant experience has now been gained in such comparisons, especially using the metric of DALYs (see Box 2.1) (WHO, 2003a).

For carcinogenic chemicals in drinking-water, guideline values have been set at a $10^{-5}$ upper-bound estimate of risk (WHO, 2004a). This is approximately equivalent to one excess case of cancer per 100,000 of the population ingesting drinking-water that contained the chemical at the guideline concentration over a lifetime. The disease burden associated with this level of risk and adjusted for the severity of the illness is approximately $1 \times 10^{-6}$ DALY (1 µDALY) (WHO, 2004a). This level of disease burden can be compared with a mild but more frequent illness, such as self-limiting diarrhoea caused by a microbial pathogen. The estimated disease burden associated with mild diarrhoea (e.g. with a case fatality rate of $\sim 1 \times 10^{-5}$) at an annual disease

Risk:  
• Pathogen count on the food  
• expected die-off  
• severeness of disease (DALY)  
• risk to fall ill
SSP Manual for more fun…

TOOL 3.4
Semi-quantitative risk assessment matrix

<table>
<thead>
<tr>
<th>LIKELIHOOD (L)</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very unlikely</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Unlikely</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Possible</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Likely</td>
<td>4</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Almost Certain</td>
<td>5</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEVERITY (S)</th>
<th>Insignificant</th>
<th>Minor</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Risk Score R = (L) x (S)

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Low Risk</th>
<th>Medium Risk</th>
<th>High Risk</th>
<th>Very High Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Score R</td>
<td>&lt;6</td>
<td>7–12</td>
<td>13–32</td>
<td>&gt;32</td>
</tr>
</tbody>
</table>

EXAMPLE

Checklist of issues to consider when...
What is safe is ethical!
How to make it safe?

We cannot test for everything.

→ indicator organisms

We cannot do test all the time.

→ evaluation of the procedure

→ standard safety measures
Looking forward to discuss with you & thank you!