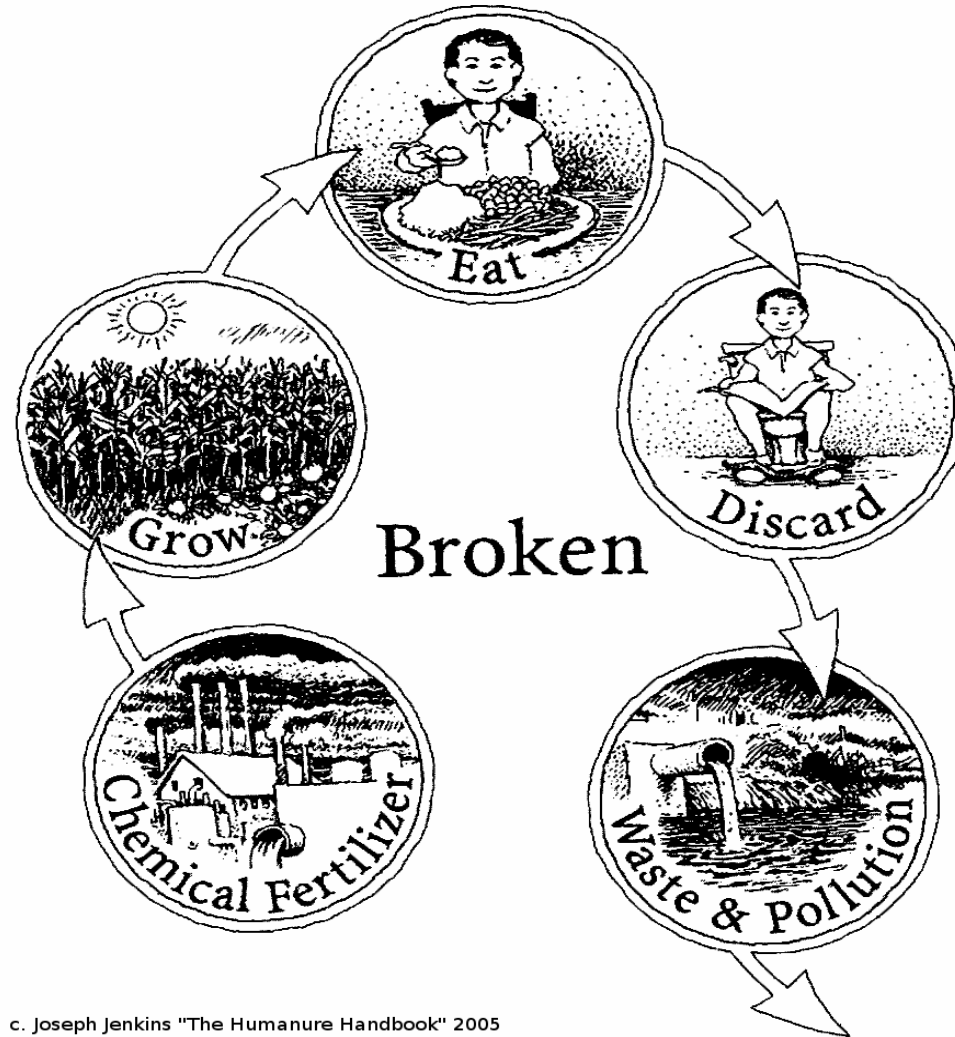


Urine Source-Separation and Reuse Impacts at the Watershed Scale

Business as usual

Energy-intensive

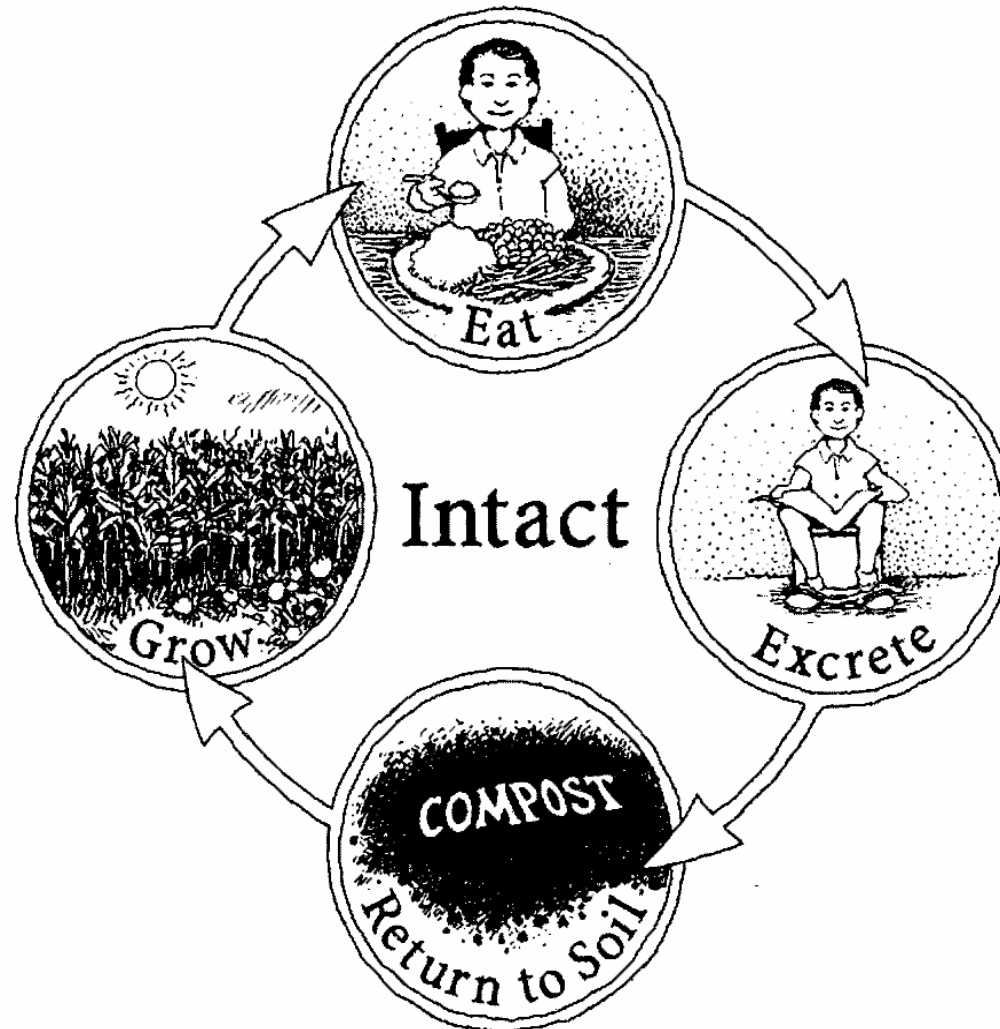
Unsustainable



c. Joseph Jenkins "The Humanure Handbook" 2005

Source-separation with nutrient reclamation

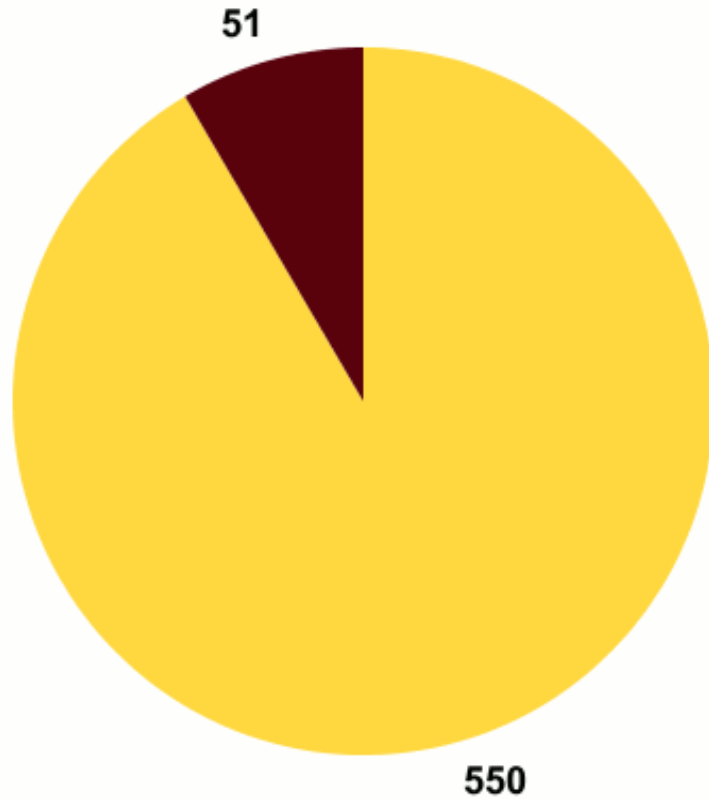
Creates fertilizer Eliminates waste



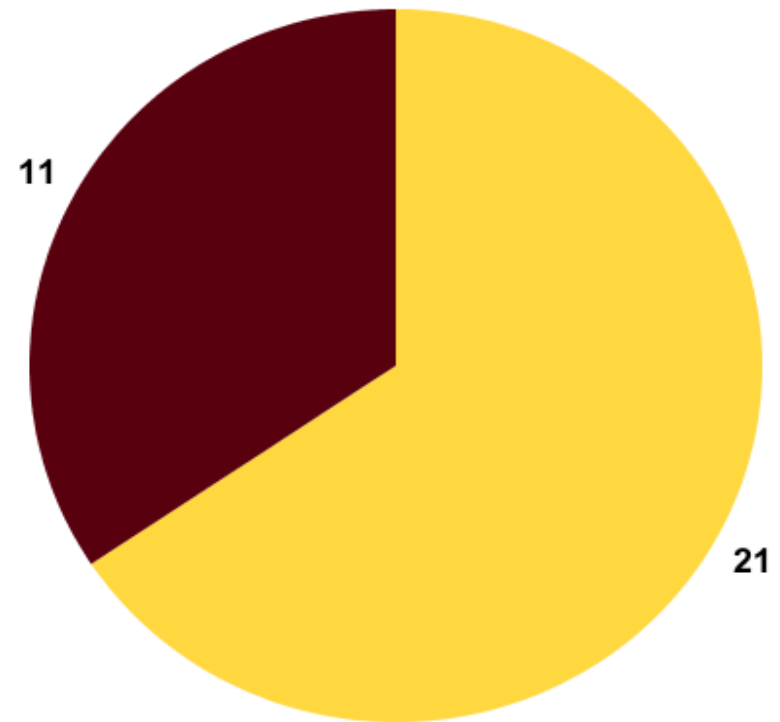
c. Joseph Jenkins "The Humanure Handbook" 2005

Characteristics of Urine

Wet mass



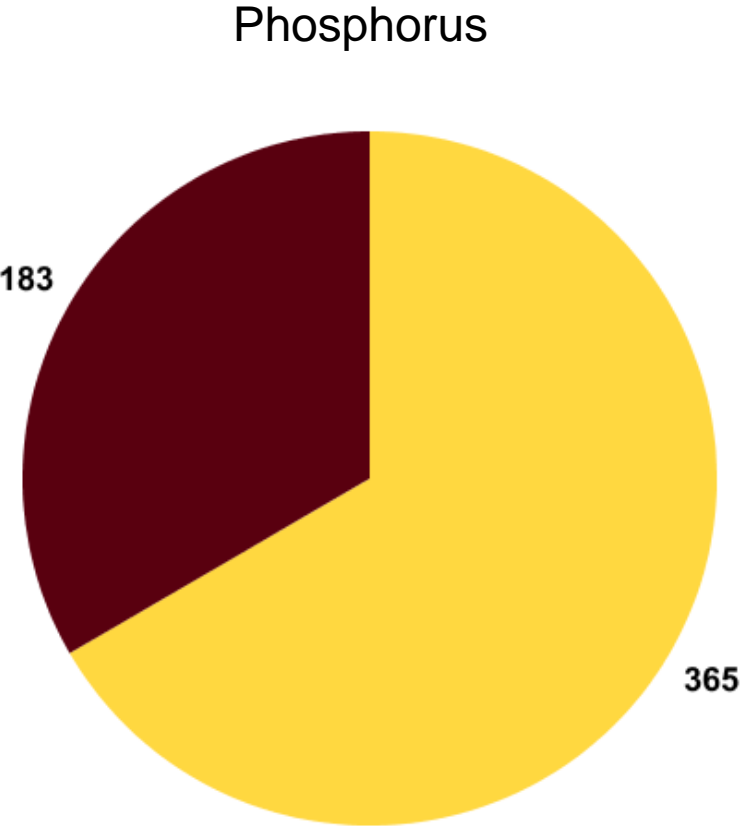
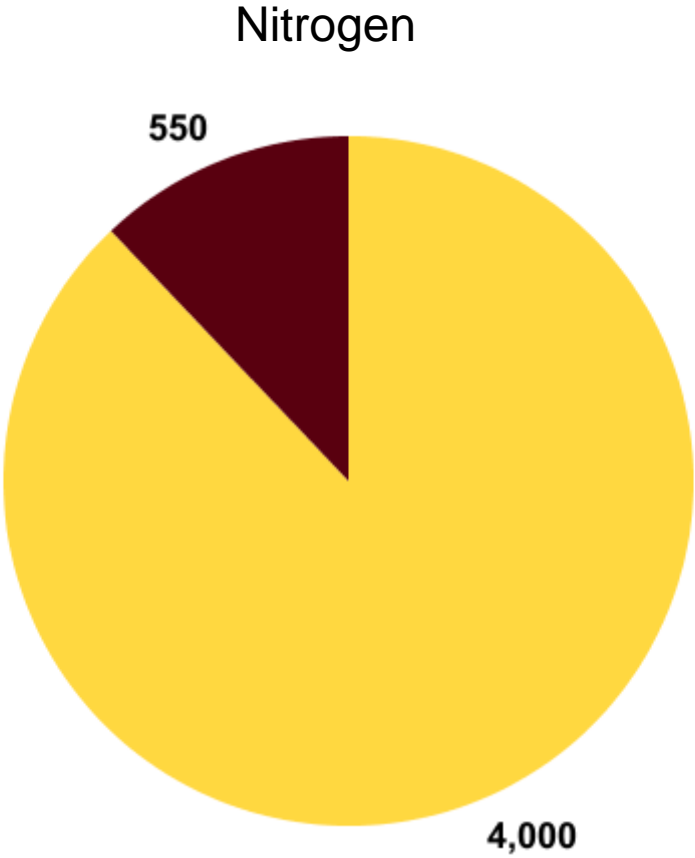
Dry mass



Urine
Feces

Annual production of urine and feces in (kg/person)

Nutrients in Urine



Urine
Feces

Grams of nitrogen and phosphorus per person/year

Sources of nutrients in wastewater

	Urine	Feces	Combined
Nitrogen	75%	5-10%	80-85%
Phosphorous	55%	25%	80%

(Larsen and Gujer 200, Otterpohl 2002, Maurer *et al.* 2006, Lienert *et al.* 2007, Vinneras *et al.* 2002, and Meininger and Oldenburg, 2009)

Source Separation



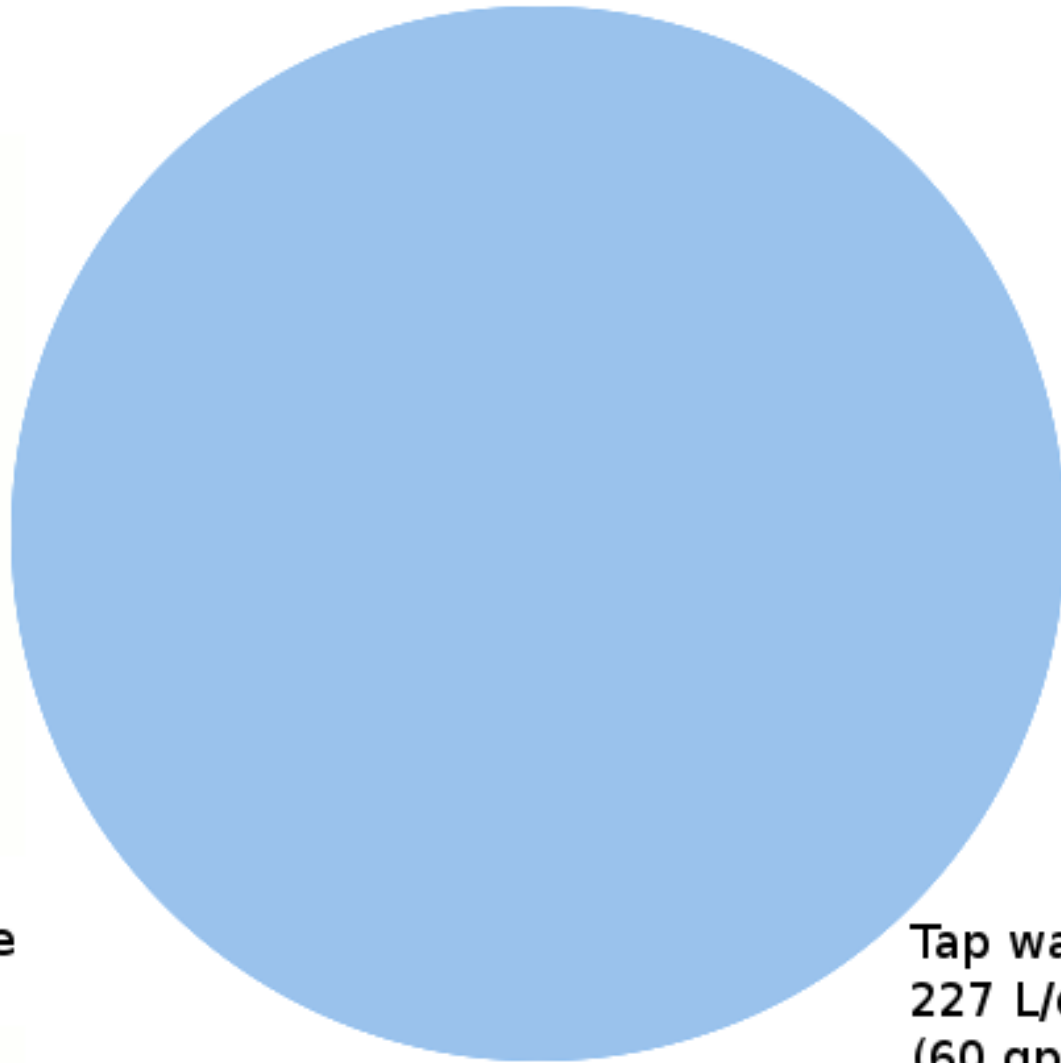
**RICH EARTH
INSTITUTE**

Fertilizer from Urine: Clean Rivers. Sustainable Farms.

What is wastewater?



Human waste
1.6 L/day
(0.42 gpd)



Tap water
227 L/day
(60 gpd)

Eutrophication



Overgrowth of algae

Blocks sunlight, killing aquatic plants

Eliminates oxygen, killing aquatic animals

Caused by excess plant nutrients

Nitrogen in marine waters

Phosphorus in fresh waters

New England hotspots for nutrient pollution

- Long Island Sound
- Cape Cod
- Great Bay



Cost to remove nitrogen



Treatment plant upgrades (Great Bay)

average \$179 - \$215

(\$7 to > \$1000 / pound N)

Sewer expansion (Cape Cod)

\$273 / pound N

Urine diversion retrofit (estimate)

\$30 / pound N

Key Aspects of Urine Diversion



Low-tech or high-tech

Centralized or decentralized

Turns a pollutant into a resource

Removes both phosphorus and nitrogen

Increasingly considered as a viable strategy