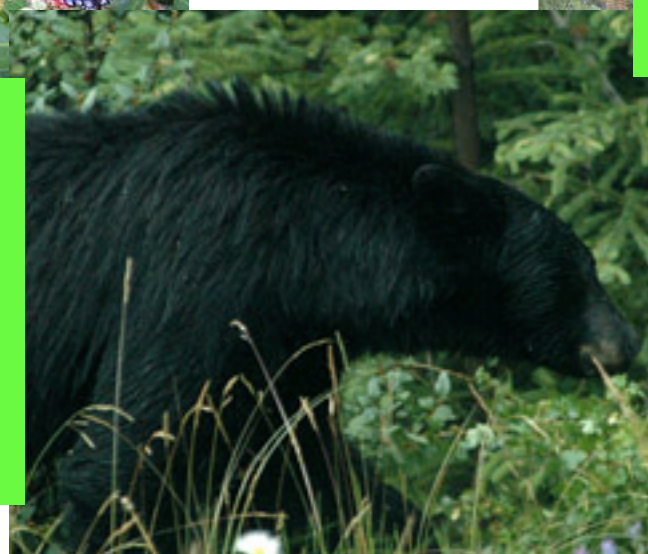


# In Natural systems: wastes are repurposed into resources



Energy from the sun is used to 'fix' atmospheric  $CO_2$  via photosynthesis. Plants take up nutrients from soils



The plant matter is used as food by a wide range of animals including microorganisms

A portion of the carbon and nutrients remain fixed (soil organic matter animal biomass) and the remainder decomposes aerobically and returns to the atmosphere as  $CO_2$



# Le Petit Journal

ADMINISTRATION  
11, rue Lafayette 11  
Ses bureaux et ses presses

5 CENT. SUPPLÉMENT ILLUSTRÉ 5 CENT.  
27<sup>e</sup> Année — 44 — Numéro 1.190  
DIMANCHE 6<sup>e</sup> DÉCEMBRE 1903

ABONNEMENTS  
UN AN 100 FR.  
UN MOIS 10 FR.  
UN SEMESTRE 50 FR.  
UN TRIMESTRE 25 FR.



LE CHOLÉRA

In Urban systems:

Dirty drinking water and inadequate wastewater treatment kill people

# So we have engineered systems – focus on public health

$$\frac{1}{\text{SRT}} = \mu = \frac{\mu_m N}{K_N + N} \left[ \frac{\text{DO}}{K_o + \text{DO}} \right] - K_{dn}$$

Solids Retention Time equation is for calculating nitrification kinetics...

$\mu$  = specific growth rate of nitrifying bacteria

$\mu_m$  = maximum specific growth rate

$N$  = Nitrogen concentration (g/m<sup>3</sup>)

$K_n$  = half-velocity constant, substrate concentration at one-half the maximum specific substrate utilization rate (g/m<sup>3</sup>)

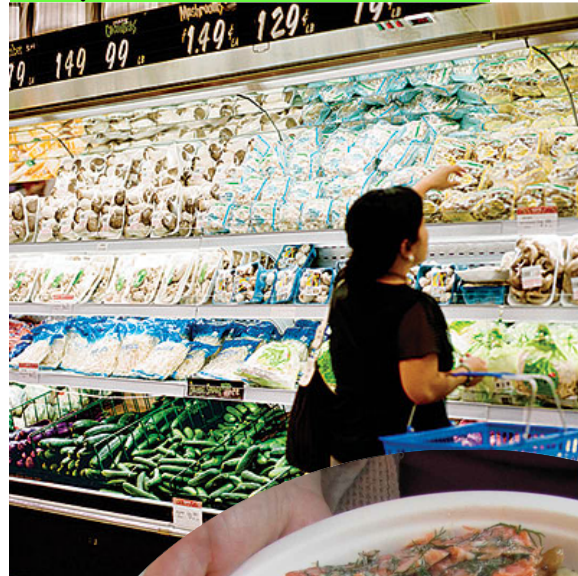
$K_{dn}$  = endogenous decay coefficient for nitrifying organisms (g Vss/g Vss-d)

$\text{DO}$  = dissolved oxygen concentration (g/m<sup>3</sup>)

$K_o$  = half saturation coefficient (g/m<sup>3</sup>)

First you go to the supermarket

We've forgotten about repurposing



The leftovers go into the garbage and you to to the bathroom



After hours of watching the cooking channel you make dinner



# I want people to remember Biosolids - product of WWT



**Water- 60-80%**

**Carbon 4-10%  
(20-50%)**

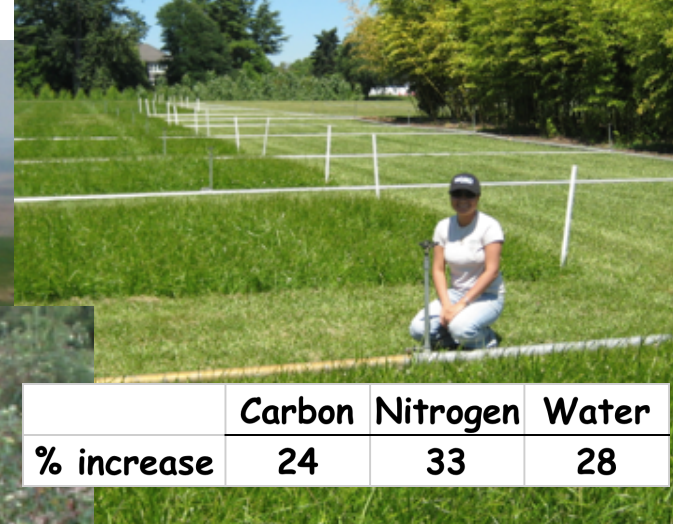
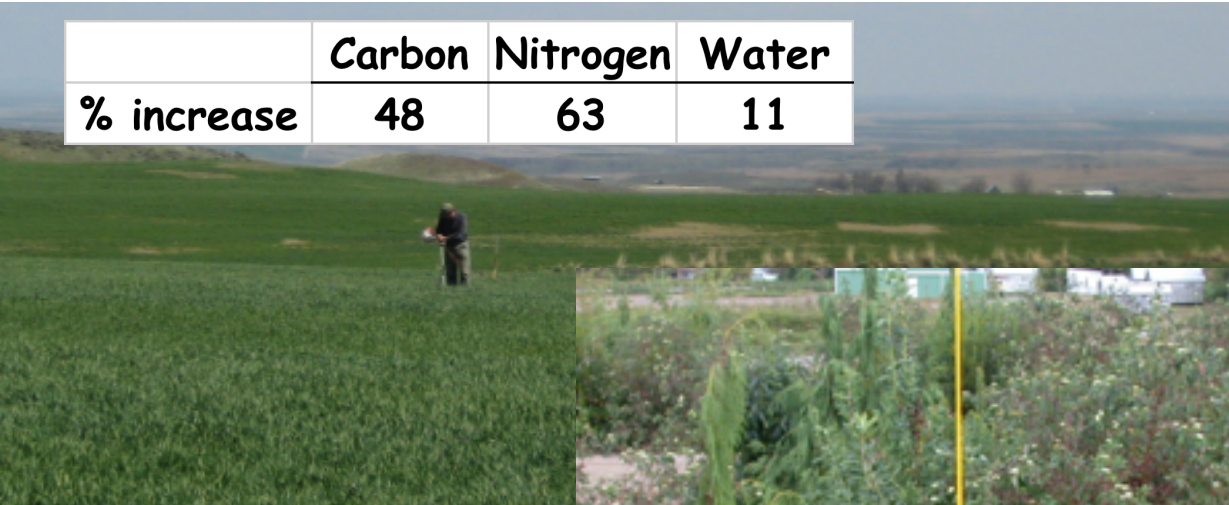
**N  
0.4  
-1.4%  
(2-7%)**

**P, S  
1-3%**

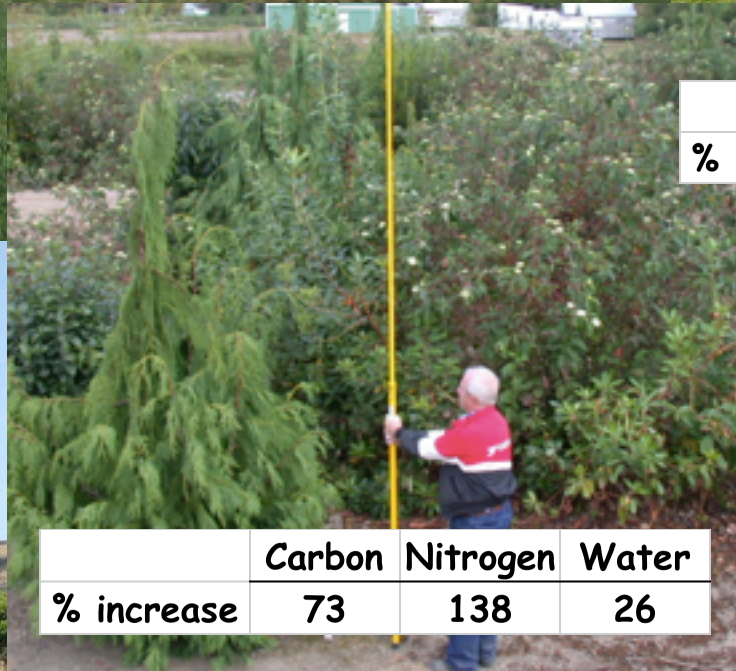
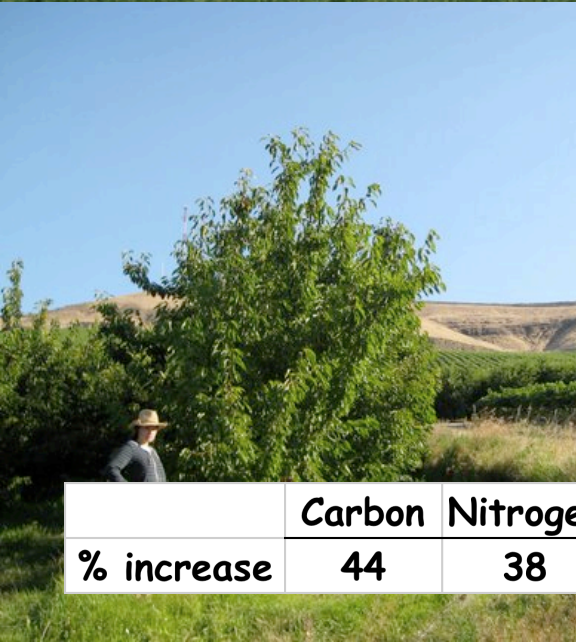
**K, Fe, Ca, Cu, Mn, Mg, Zn, B, Co**

# Amazing tool for Sustainability

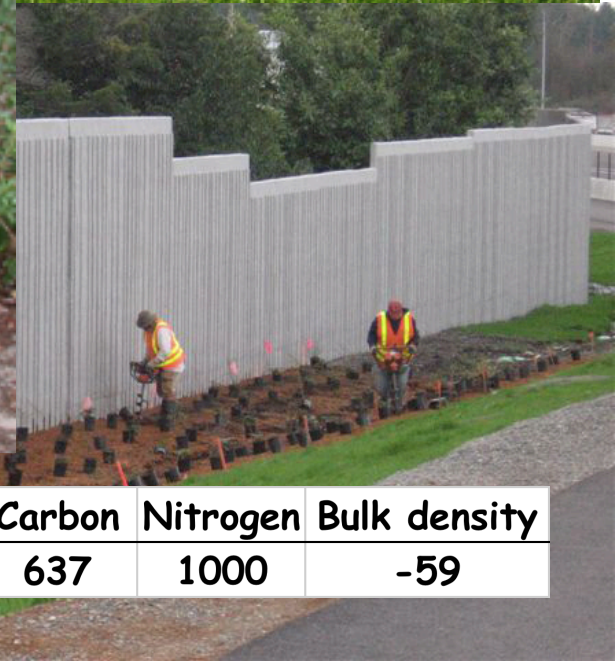
	Carbon	Nitrogen	Water
% increase	48	63	11



	Carbon	Nitrogen	Water
% increase	24	33	28



	Carbon	Nitrogen	Water
% increase	73	138	26



	Carbon	Nitrogen	Bulk density
% increase	637	1000	-59

	Carbon	Nitrogen	Water
% increase	44	38	55



Urban bears