

**WCCA6**

**WORLD CONGRESS6**  
on CONSERVATION AGRICULTURE

**WCCA6**

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# **Carbon: The Synergy Element in No-Tillage and Cover Crops**

by

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# Food Security



# Soil Organic Carbon

# Extreme Climate events 2013/2014

With 2013 the driest year on record and 2014 possibly worse, the devastation of California's drought is trickling down to crops, fields, farmers markets, grocery stores -- and the kitchen table.

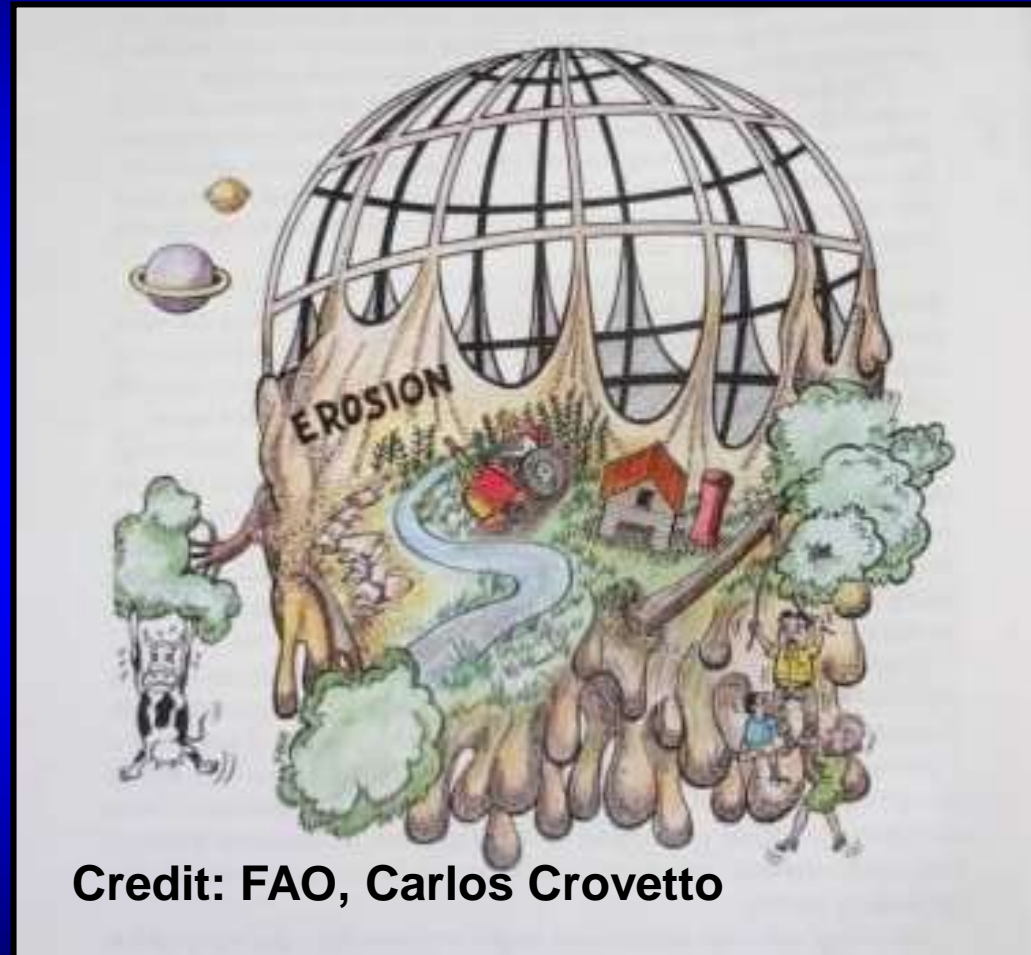


England suffered the wettest January in 248 years. Forecasters warn of more bad weather to come. It arrived in Minnesota, USA last week (June 18, 2014)!



# Is conventional agriculture eroding civilization's foundation?

Our soils are the fundamental foundation of our life and our economy. Our soils, water, air and sun are the major resources that sustain our food production. We are the stewards of those resources and must manage soil carbon to maintain sustainable production.



**Climate extremes increase soil erosion!**

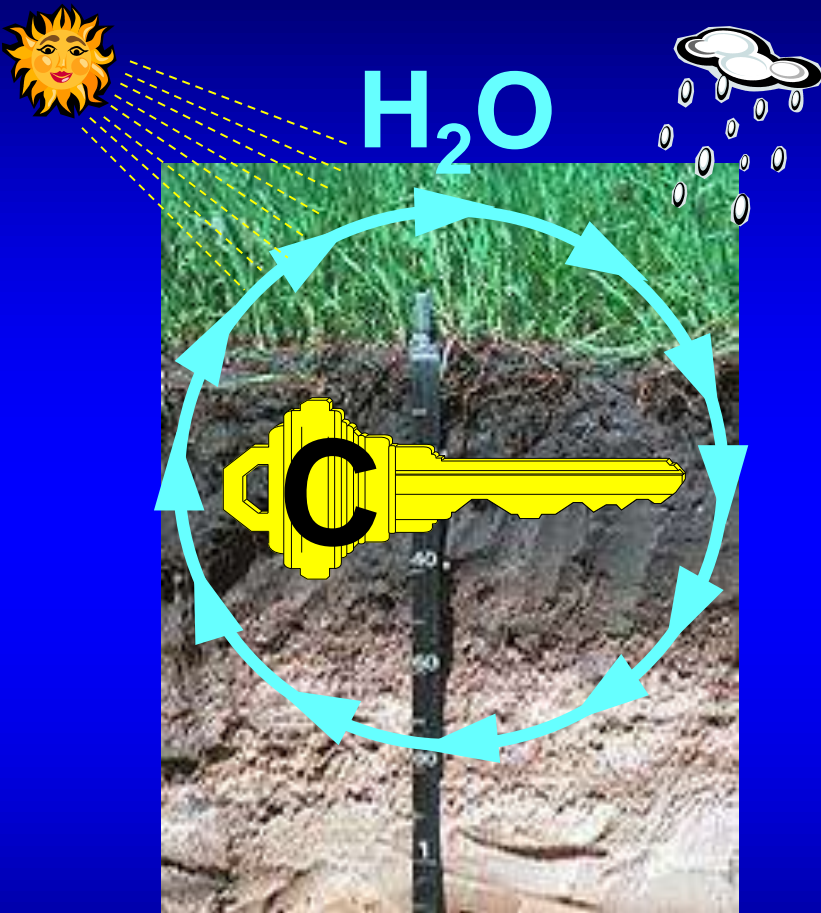
# Carbon emissions as carbon equivalents (CE), total runoff, soil loss and relative loss for various tillage systems.

<u>Tillage Systems</u>	<u>Emissions</u> (kg CE/ha)	<u>Total</u> <u>Runoff</u> (mm)	<u>Soil</u> <u>loss</u> (Mg ha <sup>-1</sup> )	<u>Rel.</u> <u>Loss</u> (--)
<b>Conventional Till</b>	<b>35.3</b>	<b>45.0</b>	<b>15.5</b>	<b>52</b>
<b>Chisel Till</b>	<b>7.9</b>	<b>28.9</b>	<b>3.3</b>	<b>11</b>
<b>No-Till</b>	<b>5.8</b>	<b>7.6</b>	<b>0.3</b>	<b>1</b>

Source: Lal, R. 2004. Carbon emission from farm operations. Environment International, Volume 30 (7): 981-990.

Source: Seta, A. K., R. L. Blevins,\* W. W. Frye, and B. J. Barfield. 1993. Reducing Soil Erosion and Agricultural Chemical Losses with Conservation Tillage. J. Environ. Qual. 22:661-665 (1993)(table 1)

# Plant carbon is our greatest water management tool!



## C Increases:

infiltration, evapotranspiration, soil tilth, soil structure, available water holding capacity, water use efficiency, water storage, root depth, soil biological activity, water quality, root and worm bio-pores, aeration, nutrient cycling, drainage

## C Decreases:

Soil runoff, erosion, evaporation, sediments, temperature, crusting, pollution, compaction, desertification,

“C” = live and dead plant leaves, stems, roots, biomass, residue, mulch layer, POM, SOM, manure, humus and humic acids.

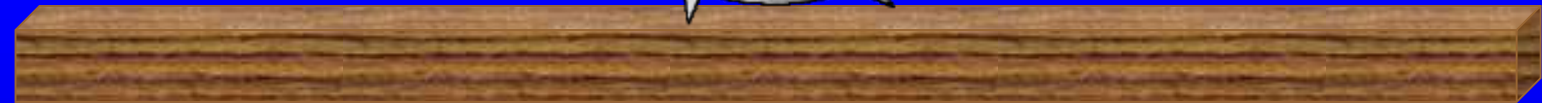
**Good carbon management is required for maximum water use efficiency.**

**Balance is the “key” to  
any healthy ecosystem.**



**No tillage**

**Cover crops**



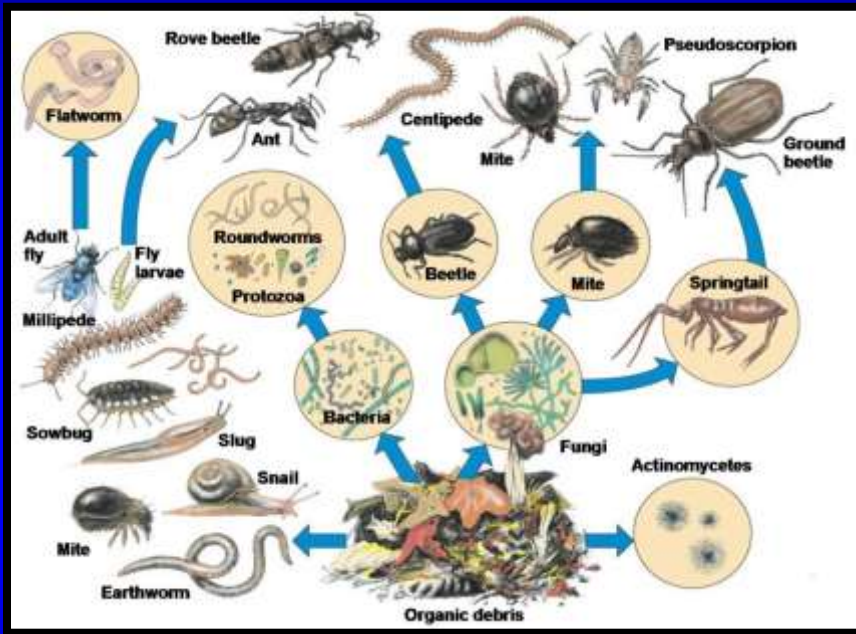
**Minimum  
carbon  
loss**

**Maximum  
carbon  
input**



**Diversity enables a more sustainable system.**

**Multi-tasking with cover crops!  
More than just erosion control!**



- 1. Fit cover crops into the rotation**
- 2. Cover the soil 100% of the time**
- 3. Carbon input 100% of the time**

*You can't have soil biology without plants as their host.*



# Biodiversity

**“C”**over **“C”**rop **“C”**ocktails

## Synergy Crops

Bringing together the individual crop benefits into a community of crops whose synergistic effects to subsequent crops are greater than the sum of the individual crop contributions.

# Nurture Nature with System Synergies



**No Tillage**

**Minimum carbon loss**



**Cover Crops**

**Maximum carbon input**

**Carbon management**

**Sustainability**

# Natural Nutrient Cycling

Crop biomass ~ 46 %C

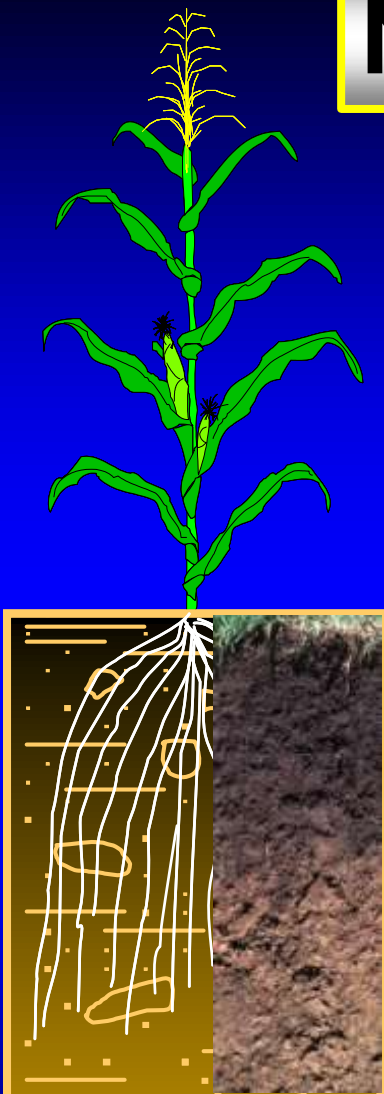
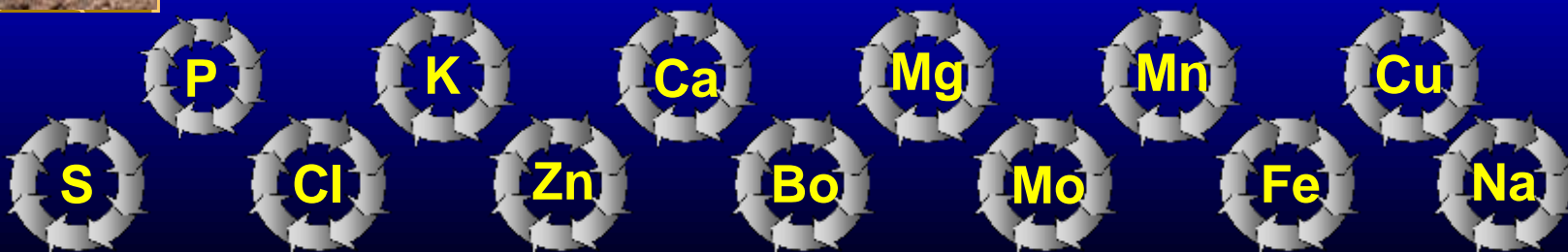
$\text{CO}_2 \leftarrow$  **Microbial and fungal decomposition**  $\rightarrow \text{CO}_2$

Biological activity =  
Nutrient release

Soil organic matter = 58 %C

Difference = 12 %C

**C, H, O, N**





**By using no-tillage and cover crop mixes, farmers are working with nature's diversity and synergy to manage carbon to achieve a better lifestyle and to protect and preserve our natural resources for Food Security.**



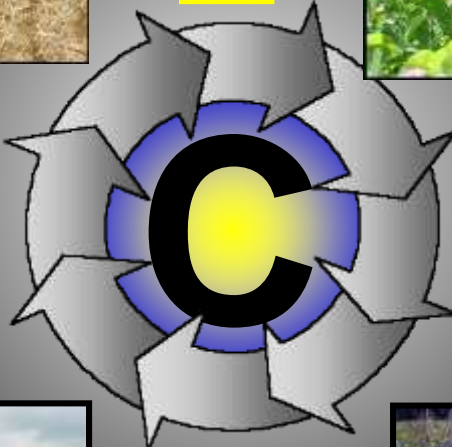


**Food Security**



**No Tillage**

**Cover Crops**



**Sustainability**

Min. soil disturbance  
 Min. soil loss  
 Cont. crop residue cover  
 Diverse rotations  
 Min. carbon loss

Soil protection  
 Feed the soil biology  
 Manage water  
 Recycle nutrients  
 Max. carbon input

