UNIVERSITY OF FLORIDA

Production and Utilization of Compost and Greenhouse Emissions

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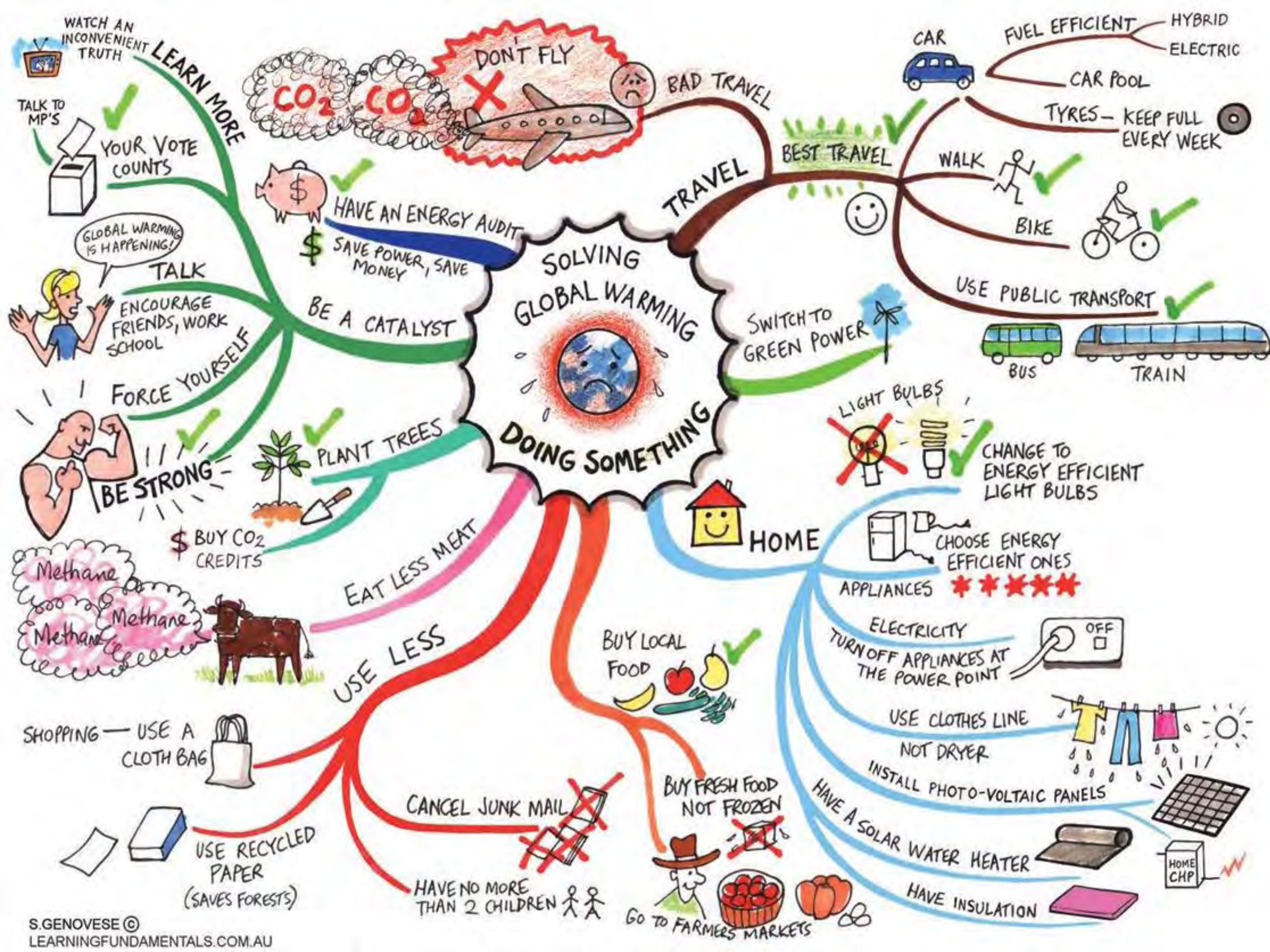
Global Warming

- Increased CO_2 in the atmosphere has been implicated in the global warming.
- Carbon dioxide (CO_2) is the most commonly discussed GHG.
- CO_2 has been "sinked" or stored overtime in the form of coal and oil deposit. When coal or oil is burned the CO_2 is released adding to the overall amount of CO_2.
- Other gases can be more effective as a GHG than CO_2 such as methane (CH_4) and nitrous oxide (N_2O). There are 21 and 270 times more effective at trapping infrared energy in the troposphere than CO_2.

Landfill or Lagoon

As CH_4 is 23X worse than CO_2 these short term organic residuals start to count



SOLVING GLOBAL WARMING
DOING SOMETHING
LEARN MORE
WATCH AN INCONVENIENT TRUTH
TALK TO MP'S
YOUR VOTE COUNTS
GLOBAL WARMING IS HAPPENING!
TALK
ENCOURAGE FRIENDS, WORK SCHOOL
BE A CATALYST
FORCE YOURSELF
BE STRONG
$ BUY CO_2 CREDITS
PLANT TREES
HAVE AN ENERGY AUDIT
$ SAVE POWER, SAVE MONEY
CO_2
CO_2
DON'T FLY
BAD TRAVEL
TRAVEL
BEST TRAVEL
CAR
FUEL EFFICIENT
HYBRID
ELECTRIC
CAR POOL
TYRES – KEEP FULL EVERY WEEK
WALK
BIKE
USE PUBLIC TRANSPORT
BUS
TRAIN
SWITCH TO GREEN POWER
LIGHT BULBS
CHANGE TO ENERGY EFFICIENT LIGHT BULBS
HOME
APPLIANCES
CHOOSE ENERGY EFFICIENT ONES
ELECTRICITY
TURN OFF APPLIANCES AT THE POWER POINT
OFF
USE CLOTHES LINE
NOT DRYER
INSTALL PHOTO-VOLTAIC PANELS
HOME CHP
HAVE A SOLAR WATER HEATER
HAVE INSULATION
Methane
Methane
Methane
EAT LESS MEAT
USE LESS
SHOPPING – USE A CLOTH BAG
USE RECYCLED PAPER (SAVES FORESTS)
CANCEL JUNK MAIL
HAVE NO MORE THAN 2 CHILDREN
BUY LOCAL FOOD
BUY FRESH FOOD NOT FROZEN
GO TO FARMERS MARKETS
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Options as a Society

- Landfill gas capture
- Anaerobic digestion
- Direct land application
- Composting

Composting Compared to Land Filling with Energy Recovery Systems

- California could reduce its GHG emissions by one million (metric tons carbon equivalent) MTCO2E by composting just 30% of the food waste that is currently disposed. This is equivalent to the C sequestered by 26 million tree seedlings grown for 10 years.

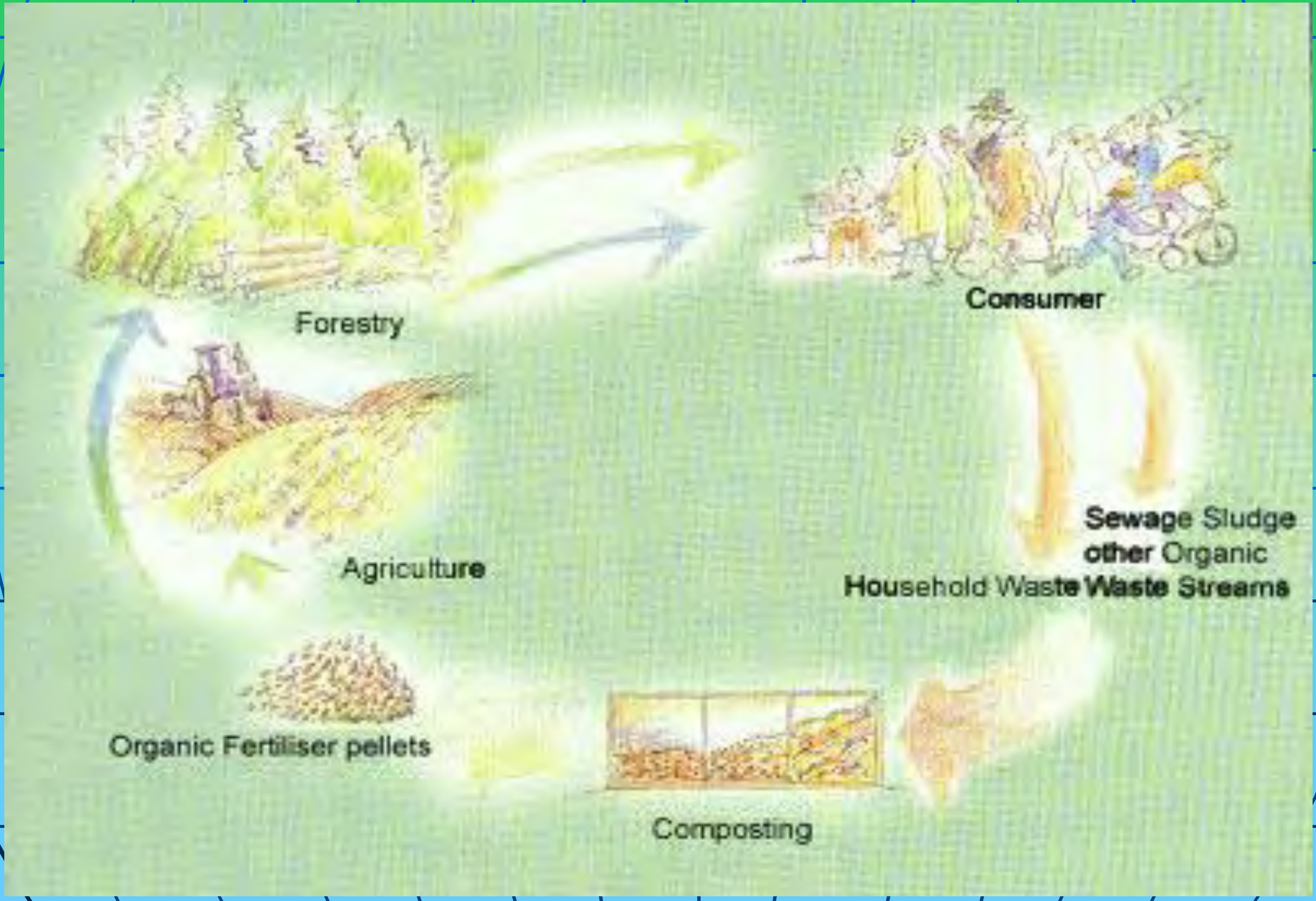
I. Composting Process

II. Compost application

Debits and Credits

- Greenhouse gas accounting is done by evaluating both the debits and credits associated with a particular practice.
- **Debits** are emissions of GHGs into the atmosphere and **credits** are essentially deposits of carbon into a fixed, stable form or C Sequestration.
- ***Avoidance***- stopping gasses from being released

I. Composting Process



Composting Process

ORGANIC WASTE

Microorganisms :

- **Fungi**
- **Bacteria**
- **Actinomycetes**

---> O_2 → Heat → H_2O --->

Stable Organic residuals

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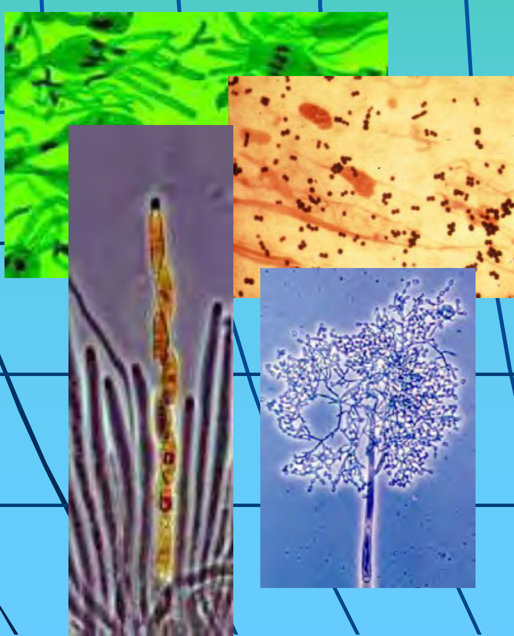
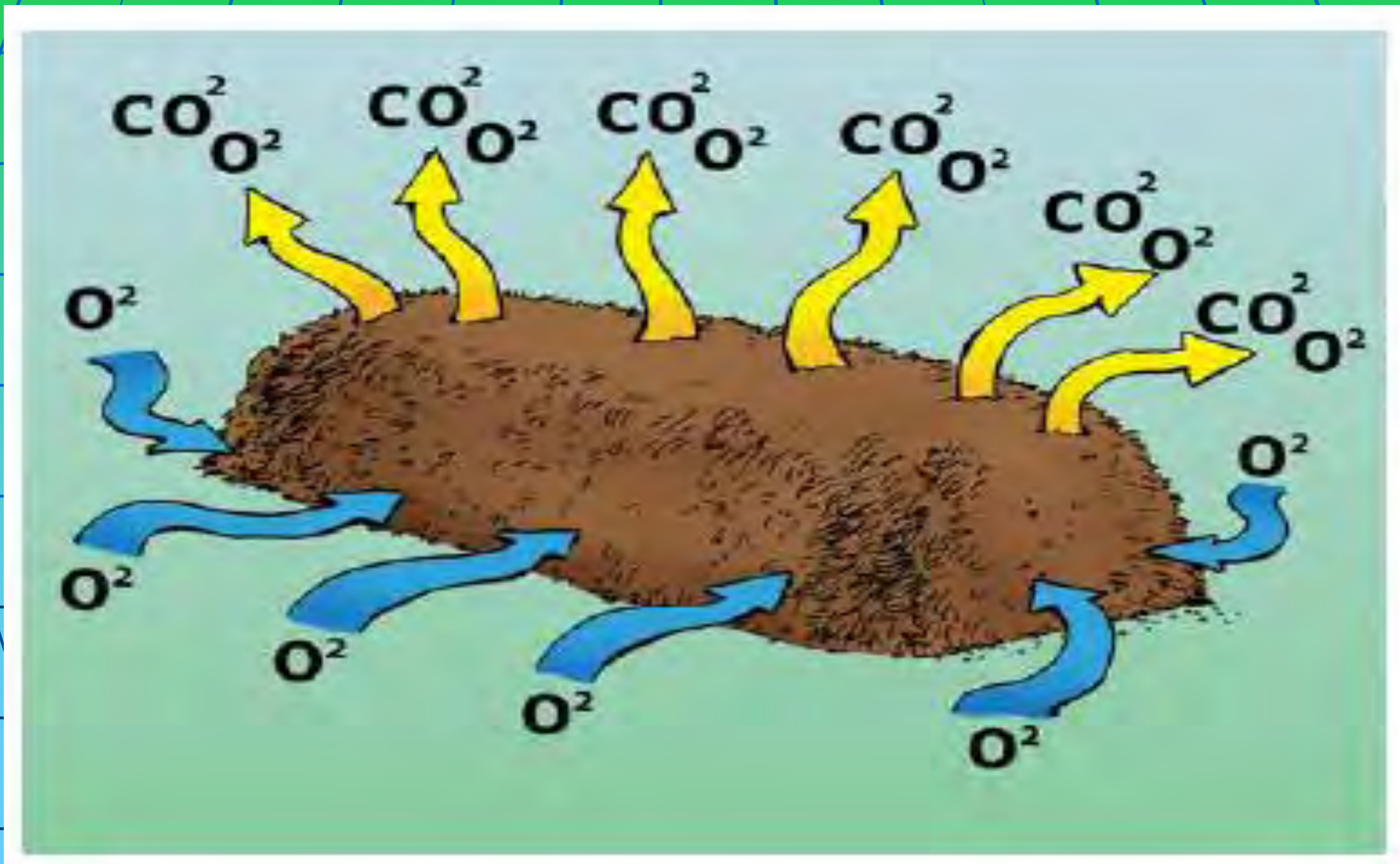
CO_2+H_2O +?$NO_x$$CH_3$? +Heat (6,000 cal)



Ideal Composting Process



Important Factor for Biochemistry of the Composting Process

- Temperature
- Moisture
- Particle size
- Chemical balance C:N
- Oxygen
- pH

Compost Accounting-
Divide Process into Three Parts

Debits and Credits

1. Feedstock's type

- The methane generation potential of different compost feedstock's.

2. Composting process

- Energy use and emissions during composting.

3. Final compost destination

- End-user of compost qualify for C sequestration

1. Feedstock's-
Methane generation potential

- Food waste- 12 Mg CO_{2equiv} per Mg food waste
- Grass clippings
  - 5.5 Mg CO_{2equiv} per Mg
- Leaves
  - 1.2 Mg CO_{2equiv} per Mg

Sally Brown USCC 2007

1. Feedstock's-Avoidance Credits

- Compost facility that processes 1,000 dry metric tons of waste per year
- Mix of 33% manure, 33% newsprint and 33% food waste
  - 333 x 2.6 Mg CO_2 for hog manure
  - 333 x 3 Mg CO_2 for newsprint
  - 333 x 12 Mg CO_2 for food waste
- 5,900 Mg CO_2- an optimum value for avoidance

2. Energy use during composting.

- Windrows.
- Static piles with or without forced aeration.
- Mechanized processes.

These requires different amounts of energy to set up and manage materials while they are composting.

Windrows Systems

- US EPA (2002) did an analysis of GHG potential from a windrow compost system and concluded that processing one Mg of feedstock requires 5.90 kg of diesel fuel (for material processing and turning). Their energy cost estimate is also expressed as 0.01metric tons carbon equivalent (MTCE) of indirect CO2 emissions per ton of material composted with the estimate including transport of material to a compost facility (363,000 Btu) and turning the pile (221,000 Btu).
- Operations with more frequent turning of piles or with piles of larger or smaller dimensions would require some adjustments to this estimate.

2. Gas emissions during the composting process

- Some CH_4 and N_2O can be produced from the compost piles the amount depending on variables as C:N ratios, bulk density and other factors. While anaerobic conditions may exist in a pile, high ammonia concentrations within the pile are sufficient to inhibit methanogenic bacteria.
- Safeguard against the release of any GHGs formed within a pile is the active aerobic microbial community on the surface of the pile. These organisms will oxidize methane before it is released into the environment

- **Well managed compost facilities do not produce any methane.**

Summary: CO_2 and the Composting Process

- Most composting operations are likely to function both as a source of GHGs and as a means to avoid GHG release at different stages of their operations

- Since is neither a loss nor gain in regard to carbon inputs or off-sets from the system as a whole.

II. Compost Application of Crop

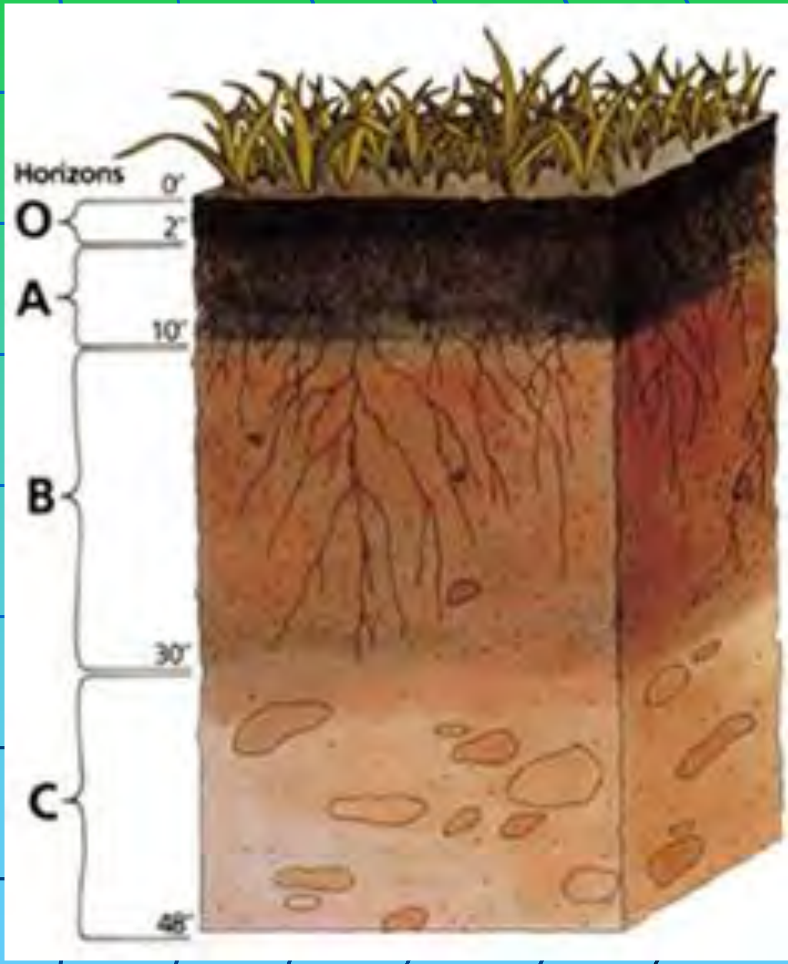
What is Composting and Compost?

- You could call it "carbon farming"
- Composting can be considered to be a C based system, similar to reforestation, and agricultural management practices.



Carbon Sequestration

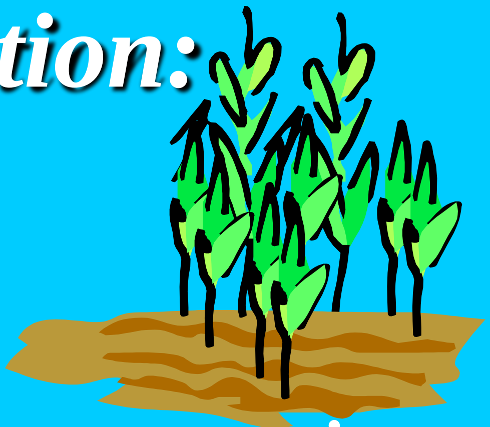
- Carbon stored in vegetation , soil, or the ocean, which is not readily released as a CO_2, is said to be sequestered.
- C is the major component of any organic matter and constitutes about 58% of the organic matter in the surface soil.



Benefits of Compost Application:

Buffers soil temperature

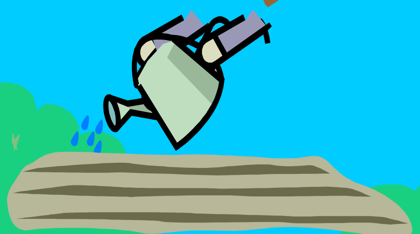
Increase water holding capacity



Increase cation exchange capacity

Prevents erosion

Organic matter helps soil tilt and structure



Increase soil microbial

Compost and Crops

1. The application of compost greatly increases the amount of C sequestered in soil or C-SINK. Experimental studies have shown that increased C sequestration in soil from composting application was 6 to 40 tons of C per hectare.

- The application of compost can results in a reduced need for GHG producing petroleum-based chemical fertilizer, pesticides, herbicides, and additives. Less depend on fossil fuel inputs.

Compost and Crops

- Plants grown in compost-rich soil require less irrigation because of the increased infiltration and storage capacity of root systems and the reduction of water runoff, evaporation, and water usage by weeds.
- Research has shown that the application of compost can reduce the need for irrigation by 30-70% massive water supply infrastructure, a substantial decrease in water consumption would significantly reduce energy consumption.

Ornamentals Plants

Golf Courses and Athletic Fields

Vegetables


Citrus Production

Pastures

Erosion Control

Forestry Crops for Energy production


Bio-remediation

Conclusions:

Emissions and Credit in Compost and Composting

- The stages of a composting operation that have the potential to impact GHG emissions include selection of feedstocks, transport to and from the compost site, energy use during composting, gas emissions during composting.
- The credited portions of the composting process include diversion of feedstocks from storage or disposal where they would generate CH4 as well as end use of compost products.