Adapting dryland crop production

As **rainfed crops** are particularly vulnerable to **drought** as well as **heavy rain**, farmers must prepare **dryland farming solutions** for resilient and sustainable crop production.

These approaches in include:

- **Soil conservation** against the risk of heavy rain
- **Cover manure/cover crops** for soil conservation (heavy rain) and to increase soil organic matter to guard against the effects of drought and to improve soil condition and fertility
- **Not burning** crop residues
- Selection of **drought-tolerant field crops**
- **Expansion of terraced rice paddy fields** in the uplands
- **Diversification of field crops**
- Crop diversification with **perennial crops** (agroforestry)
- Proper management of **rotational farming**




Adapting dryland crop production

Soil conservation protects against the risk of soil loss from heavy rain

- One soil conservation alternative is called **alley cropping** in which series of contour hedgerows comprised of nitrogen-fixing trees (NFTs) are used to conserve hill field soil. Crops are grown in the alleys between the hedgerows

- Besides NFTS, certain **grasses**, such as napier (a forage grass) and vetiver, may be used to create contour hedgerows

- Other crops, such as **pineapple**, may be used to create contour hedgerows. Besides conserving the soil, pineapple fruits boost hill field productivity.

Adapting dryland crop production

Cover cropping against soil erosion and the loss of soil N

- The use of **green manure/cover crops** (gm/ccs), along with appropriate crop residue management, helps to provide soil cover during much of the rainy season for the **control of erosion and weeds**
- Various **effective gm/ccs** grown in SE Asia include lablab bean (*Lablab purpureus*), rice bean (*Vigna umbellata*), cowpea (*Vigna unguiculata*) and jack bean (*Canavalia ensiformis*)
- Depending on the gm/cc species, coverage can extend into the **dry season**, helping to **prevent soil N from volatilizing** into the atmosphere and keeping the **soil surface cool**

Adapting dryland crop production

Cover cropping to improve soils, hedge against drought and sequester C

- Decomposing gm/cc residue will increase levels of **soil organic matter**, thereby improving soil structure. Higher levels of soil organic matter will help the soil to **better retain moisture** during periods of drought
- Cover cropping and appropriate management of crop residues (not burning) will enable **dryland fields to absorb carbon**; a form of climate change mitigation

Adapting dryland crop production

Expansion of terraced rice paddy fields for more secure rice production in the uplands wherever possible

Adapting dryland crop production

Resilience through **diversified perennial crop systems**

- Trees, palms, grasses, and other **long-lived crops** offer the unique possibility of crops grown for basic human food that can simultaneously **sequester carbon**, **stabilize slopes**, and **build soils** as part of **no-till perennial agricultural systems**.
- Perennial crop systems are **resilient** in the face of **extreme weather**, surviving drought, flooding, and storms better than most annuals
- **Monocultures** (single-species plantations) appear to **sequester less carbon**, are **more fragile** in the face of pests and extreme weather events

Eric Toensmeier, The Overstory #248, Perennial Staple Crops

Adapting dryland crop production

Crop diversification with perennials – **Perennial staple crops**

This group of crops includes grains, pulses (dry beans), nuts, dry pods, starchy fruits, oilseeds, high-protein leaves, and some more exotic products like starch-filled trunks, sugary palm saps, and aerial tubers

Eric Toensmeier, The Overstory #248, Perennial Staple Crops

Adapting dryland crop production

Agroforestry – Production of **non-timber forest Products**

Biodiversity, productivity, resilience and carbon sequestration

Adapting dryland crop production

Shifting cultivation – Climate change hero or villain?
Ban Hin Lat Nai village (Karen) case Study




- There are a total of **17 households** and a population of **93 people**
- Livelihood from **rotational farming**, **terraced rice paddies**, **tea gardening** and collecting **food from the forest**
- More than **90 percent** of **household food** is **home grown**
- More than **90 types of food plants** and **28 types of animal products** are available in the community
- Approximately **54 percent of food plants** comes from the **rotation farming** fields, **33 percent** from **terraced paddies** and the rest is available from the **community forest** and **tea gardening**

Prasert Trakansuphakon. 2011. Changing Strategies of Shifting Cultivators to Match a Changing Climate

Adapting dryland crop production

Shifting cultivation – Climate change hero or villain? Ban Hin Lat Nai village (Karen) case study

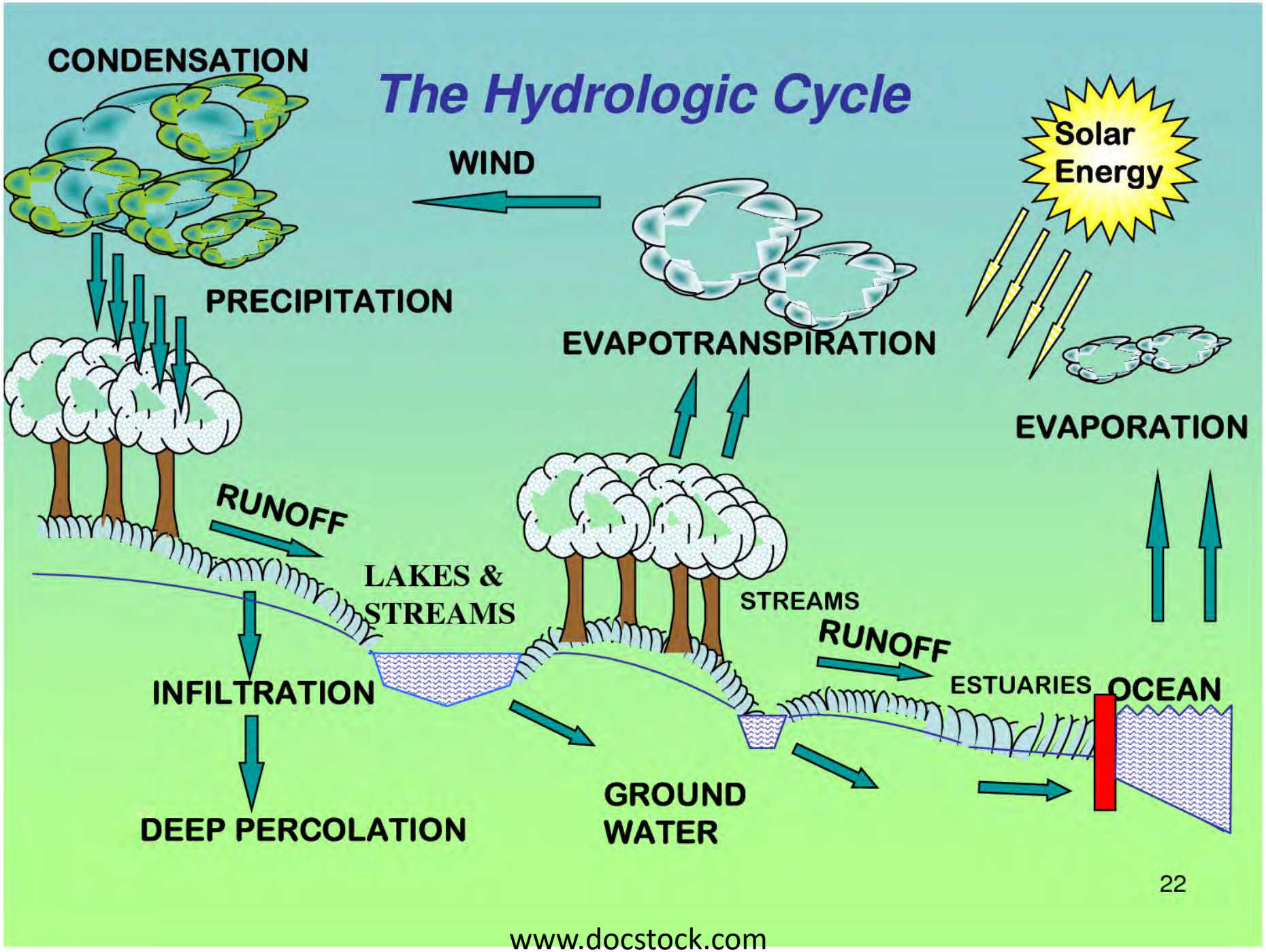



- Naturally **recovering forest** has a **high capacity to absorb carbon**
- **Rotational fields** which are left to recover up to **7 years** also have a potential to **absorb carbon** (Blaser, 2009)
- **Rotational fields** have the capacity to absorb about **6 tons of carbon /ha/year** (Somsak Sukkhawong, RECOFTC, 2010)
- Concerning Ban Hin Lat Nai's shifting rotation agriculture (forest fallow of up to 10 years) covering 1,476 *rai* (236.16 ha) of land, **net carbon storage** from this kind of farming system accounts for **17,643 tons**, whereas **carbon dioxide emission** from the burning rotation fields is only **476 tons**

Prasert Trakansuphakon. 2011. Changing Strategies of Shifting Cultivators to Match a Changing Climate

Lesson 2. Water – The Cycle of Life

- **Main Points:**
  - Water is essential for all life, for people, plants and animals
  - How much water we have and how we use this water determines the productivity of our land
  - Water flows in a cycle
- **How water moves off the land -**For farmers the most important part of the water cycle is what happens to the rainwater once it reaches the soil. After it rains, 1 of 3 things can happen:
  - **Infiltrate:** It can seep into the soil going underground *(useful for plants, needs to be maximized)*
  - **Runoff:** It can move across the surface of the field and go into a ditch, stream, river *(lost to farmer, causes erosion)*
  - **Evaporate:** Because of effects of the heat and the sun, it can also evaporate and return to the atmosphere *(lost to the farmer)*



Problem: Surface Runoff

Erosion: Water that runs off the soil surface too quickly and carries away the soil from fields and unprotected areas.

- The best layer of soil for growing crops is topsoil
- Preventing soil erosion essential to livelihoods

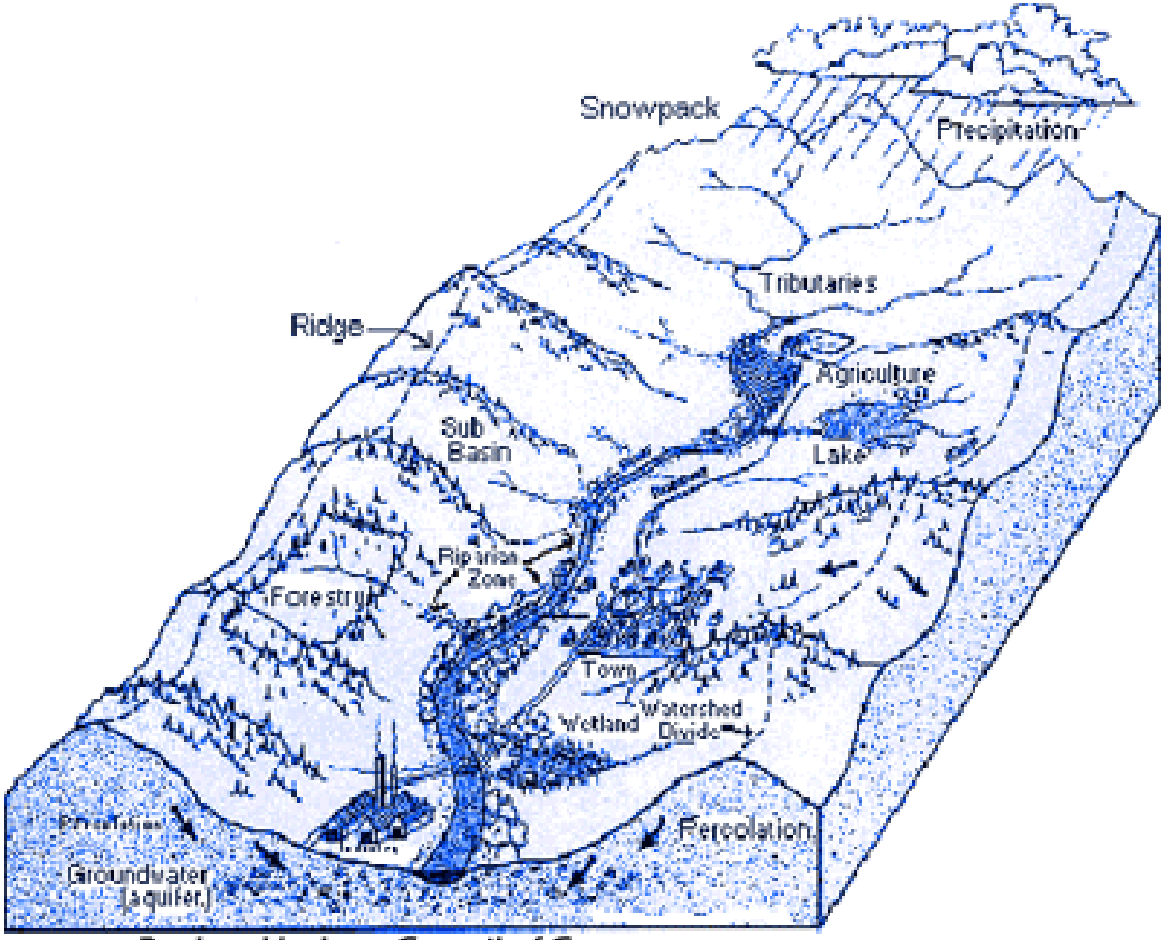
Flooding: Large amounts of water spill over rivers and lakes

- People, animals, plants, infrastructure are affected by floods

Drought: If water leaves the land too quickly, no infiltration and recharge of ground water

Prevention: Keeping trees and **grass cover** on the upper slopes to slow down runoff; taking measures to **prevent erosion;** and **capturing more water in the soil or in small dams**

Watersheds and Watershed Management



Produced by Lane Council of Governments

- "**Watershed**" = an area from which all of the rainfall drains into a common outlet or water-body
- Watersheds can be small – that all drain into one gully or stream
- Watersheds an also be large, covering thousands of hectares and many small water bodies

- **Things to Remember:**
  - It is **important to manage** rainfall across the **entire watershed**
  - It is impossible to manage one part of a watershed effectively without **looking at the bigger picture upslope and downslope**

Hotspots: How to Identify Problem Areas

- Problem areas or **hotspots**- usually caused by run-off that moving too fast and therefore causing erosion.
- Looking for **signs of erosion** or potential for erosion:
  - Areas of **bare soil on a slope**, with no vegetation
  - Places where **gullies** are forming
  - Areas where **plant roots are exposed**
  - Areas where **heavy rain turns streams muddy**

Good Practices for Farming and Managing the Natural Environment

- All excess water should "walk, not run" off the slope
  - This will prevent erosion by ensuring excess water does not carry away the topsoil
  - Use tools such as contour ditches, dams, terraces to slow and stop water erosion

How to Protect Existing Organic Matter:

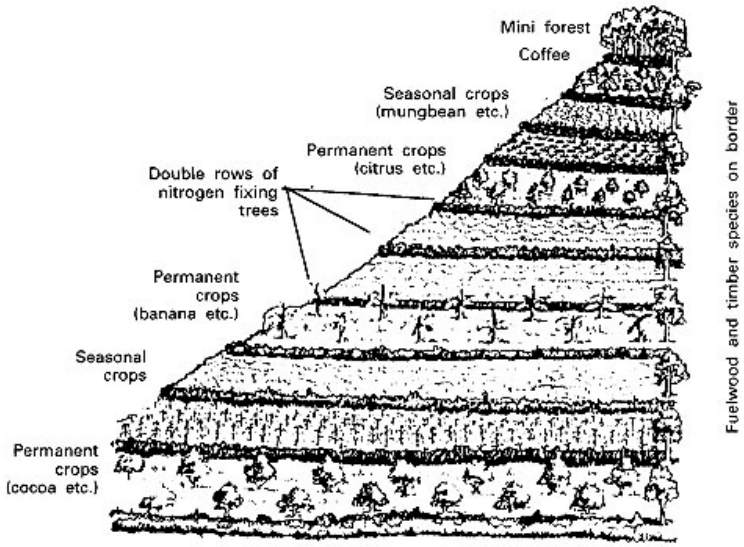
- **Do not use burning to clear land for crops**
  - Burning weeds and vegetation removes OM
  - Unburned soils have twice the number of important nutrients (carbon and nitrogen) and twice the number of soil animals
  - Burned soils degrade faster

How to Protect Existing Organic Matter:

- **Protect soil cover and organic matter from livestock:**
  - **If uncontrolled grazing allowed,** livestock often eat or trample much of the plant material that would otherwise remain in place and protect the soil against erosion and reduces OM
  - One way to prevent this is to control free grazing by carefully tending to your livestock
  - Another solution is called “cut and carry forage”

How to Protect Existing Organic Matter:

- **Use contour rows and control rows**
  - **SALT (Sloping Agricultural Land Technology) is one way**
    - Developed in Philippines
    - Uses leguminous trees to hold soil in place and fix nitrogen
  - Can be adapted into various agroforestry schemes
  - Simply row up organic matter



How to Increase Existing OM:

- **Mulch:** Leaving a layer of dead plant matter on the surface of the soil
  - Can help control weeds
  - Adds nutrients
  - Keeps the soil damp longer
  - Increases soil biota

How to Increase Existing OM

Green Manure / Cover Crops:

Certain plants increase N in the soil

- Grown primarily to improve soil fertility
- Usually cut and left on surface of the soil while still "green"
- Sometimes a GMCC can be grown next to a cereal crop (like maize)
- Other times the dead plant parts can be left on the soil surface before planting the cereal
- GMCCs include beans, cowpeas, peanuts (groundnuts), clover, alfalfa and the leaves of some trees (for example, *Leucaena leucocephala* and *Gliricidia sepium*)

Rice Bean
www.css.cornell.edu

Jack Bean
www.ufl.edu

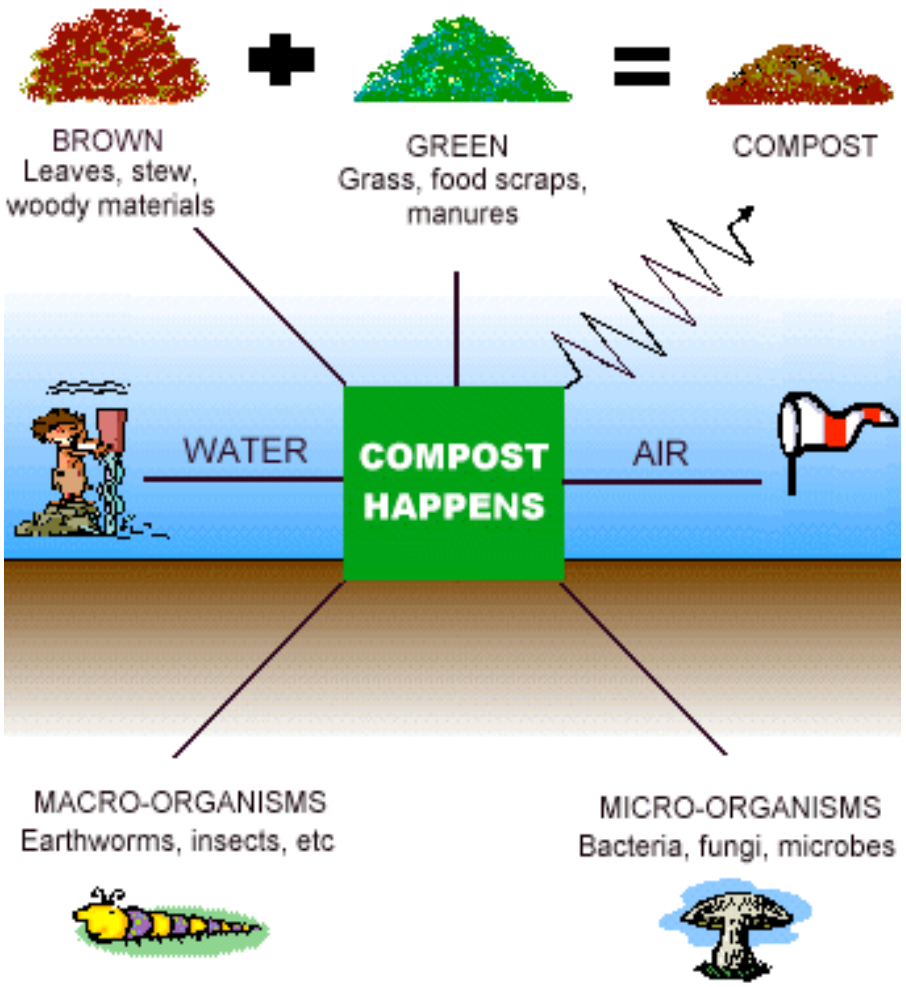
How to Increase Existing OM

Livestock manure

- Animal wastes can be mixed into topsoil or added to a compost pile
- Natural farming- pigs raised on rice husks and sprayed with EM

Compost: mix of organic materials: soil, dead leaves, stalks, vegetable scraps and ash from cooking fires, eggshells and animal manure

- Compost breaks down into a rich, dark mixture called **humus**
- Full of richly concentrated nutrients



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