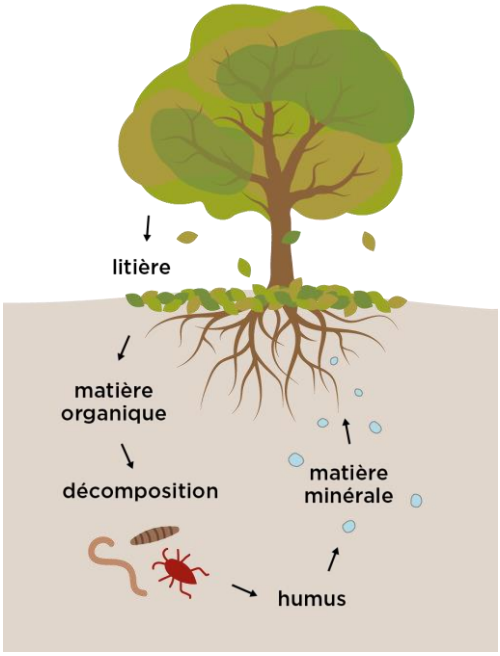
Fertilization and Soil Protection

How to protect the soil?

Soil is the medium from which plants draw the water and **nutrients (N, P, K, Mg, Ca** etc.) they need. Soil organic matter (SOM) (humus) is the dark earth that comes from the decomposition of living products (leaves, excretions). It is capable of **retaining and then supplying nutrients** and water to the crop, particularly in sandy soils. Organic matter also prevents **acidity**!



⚠ IF THE SOIL LOSES ITS ORGANIC MATTER, IT WILL NO LONGER BE ABLE TO RETAIN NUTRIENTS OR WATER, AND YIELDS WILL BECOME POOR.

How is organic matter (OM) lost?

1. **Erosion:** water or wind carries away soil and OM.
2. **Decomposition:** OM decomposes in the soil if the soil is exposed to open air.
3. **Crops:** OM is found in crops that are removed from the soil.

What can I do?

- Protecting the soil and its OM from rain: **anti-erosion** measures
- Protect the soil and its OM from air: **limit soil turnover**
- **Add OM to compensate for losses**: add manure, compost, mulch or grow green manures.

⚠ NO MATTER WHAT WE DO, WE'RE GOING TO LOSE MO, SO IT'S ESSENTIAL TO ADD MO EVERY YEAR!

Fertilization and Soil Protection

Erosion control

Erosion is the loss of soil carried away by rain, runoff or wind. Soil becomes impoverished as its upper layer containing organic matter is removed. On average, **1.5 m of fertile soil is formed in 10,000 years**, hence the fundamental importance of protecting soil from erosion.

How to prevent erosion?

Intercropping: optimizing use of space and therefore better soil cover

Crop rotation: cover the soil at all times

Agroforestry or semi-agroforestry: strata cultivation to intercept wind and rain

Growing green manures between crops: covering the soil

Mulching: covering the soil between crops

Conservative tillage:

→ Soil should only be worked superficially and locally where the crop is to be planted.

Hedges and belts: block runoff

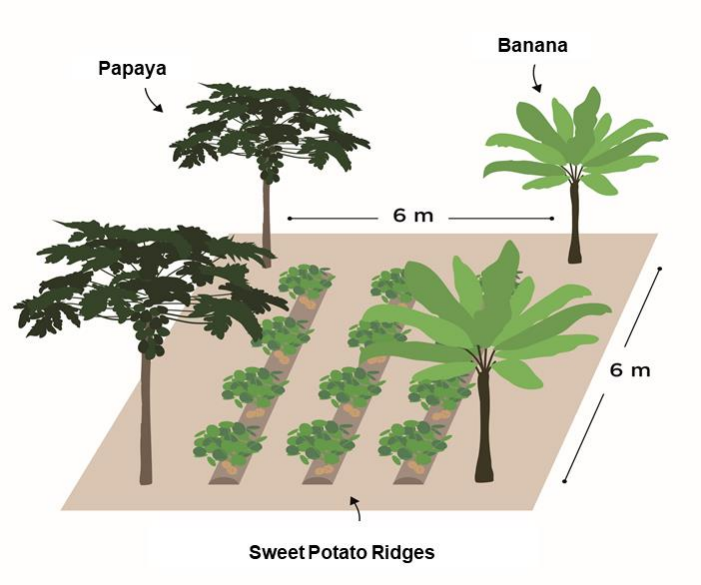
Stone barriers, zaïs holes, half-moons, logs, and mounds: block runoff

Fertilization and Soil Protection

Semi-agroforestry

Semi-agroforestry is the **association of annual crops** with fast-growing perennial crops. It is a **non-permanent agroforestry system**. The system is established for 3 to 6 years. Perennial crops that grow quickly and are easy to remove are chosen: **Papaya, Banana, Plantain, Pineapple, Cajan Pea, Moringa**. These crops, planted at a spacing of 4m x 4m or 6m x 6m, protect the annuals and above all the soil against erosion (interception of rain, wind and runoff).

Between the perennials, crops that are dangerous to the soil (often tubers) or crops that enjoy shade are planted. In the hot season, any crop can benefit from shade. Crops suited to this system include **yams, manioc, sweet potatoes, potatoes and hot-season vegetables**.



Semi-agroforestry scheme with papaya and banana trees. Potatoes are grown on the ground.

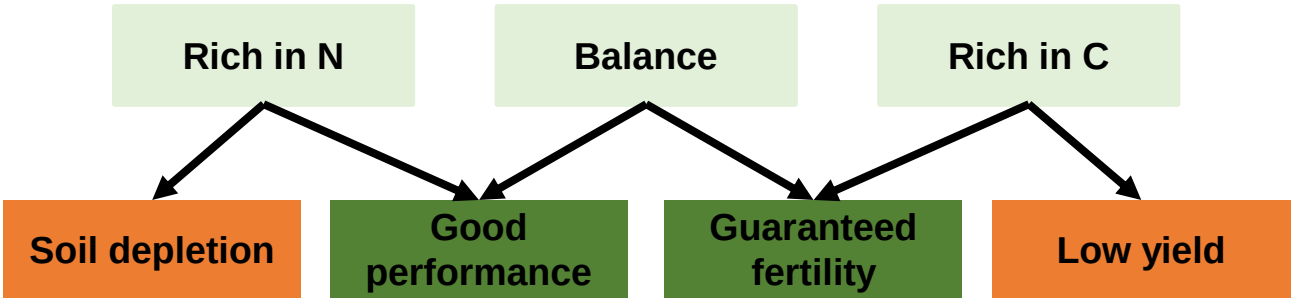
A semi-agroforestry plot (banana, papaya, pineapple) before sowing the annual crop.

Fertilization and Soil Protection

Fertilization planning

Soil Organic Matter (SOM) is essential for soil fertility and good yields.

- It is important to add **Carbon** C to create SOM and maintain soil fertility over the long term. **If there isn't enough carbon in the fertilizer, the soil will be depleted.**
- It's important to **add Nitrogen** N to nourish the plant and achieve high yields. If there's not enough nitrogen in the fertilizer, yields are poor.



A few rules for effective, sustainable fertilization!

- Combine **N-rich fertilizers for yield** with **C-rich fertilizers for fertility**.
- Apply the C-rich fertilizer **several weeks or months before** the crop to allow it to decompose.
- **Never** apply mineral fertilizers alone.

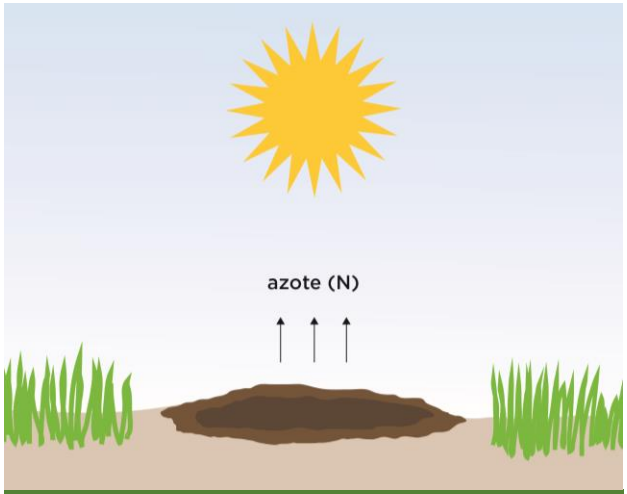
Category	Fertilizers
Mineral Fertilizers (Only N)	Synthetic: Urea, DAP etc.
	Urine
N-rich fertilizers	Decomposed chicken manure
	Fresh chicken manure
	Decomposed ruminant manure (2-3 months)
Balanced fertilizers	Fresh ruminant manure without straw
	Decomposed ruminant manure with straw
	Compost
C-rich fertilizer	Fresh ruminant manure with straw
Fertilizer very rich in C	Green mulch
	Dry mulch

Fertilization and Soil Protection

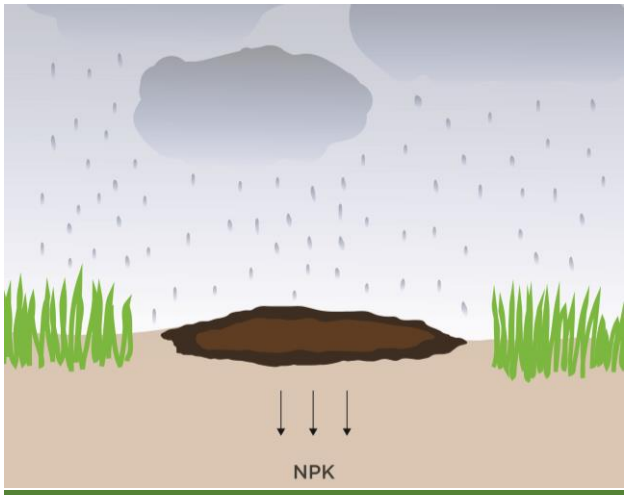
Proper manure management

Ruminant manure	Chicken manure
• Excellent **base fertilizer** • Early application **boosts** growth and yield. • Contains **all nutrients** in a balanced way. • **Rich** in organic matter: essential for maintaining soil fertility.	• **Excellent, fast-acting** fertilizer: apply at a precise moment (earing, fruiting) to increase yield. • Rich in **base minerals (Ca, Mg, K)**: ideal for vegetables and tubers, reduces soil acidity, do not overdose (max 10 t/ha)! • **Low in organic matter**, insufficient to maintain fertility.

- **Store away from rain** (pit, bags under cover)
- **Cover** to prevent contact with air (tarpaulin, sheet metal, closed bag)
- Collect manure quickly to prevent it from **drying out in the open air**.
- **Immediately mix** the soil with the manure when it is applied.
- Apply between **5 and 12 t/ha** depending on crop.
- Apply ruminant manure before sowing and manure during cultivation.



⚠ MANURE LOSES NITROGEN IF IT COMES INTO CONTACT WITH AIR AND DRIES OUT!



⚠ MANURE LOSES ITS NUTRIENTS IF IT RAINS ON IT (LEACHING)

Fertilization

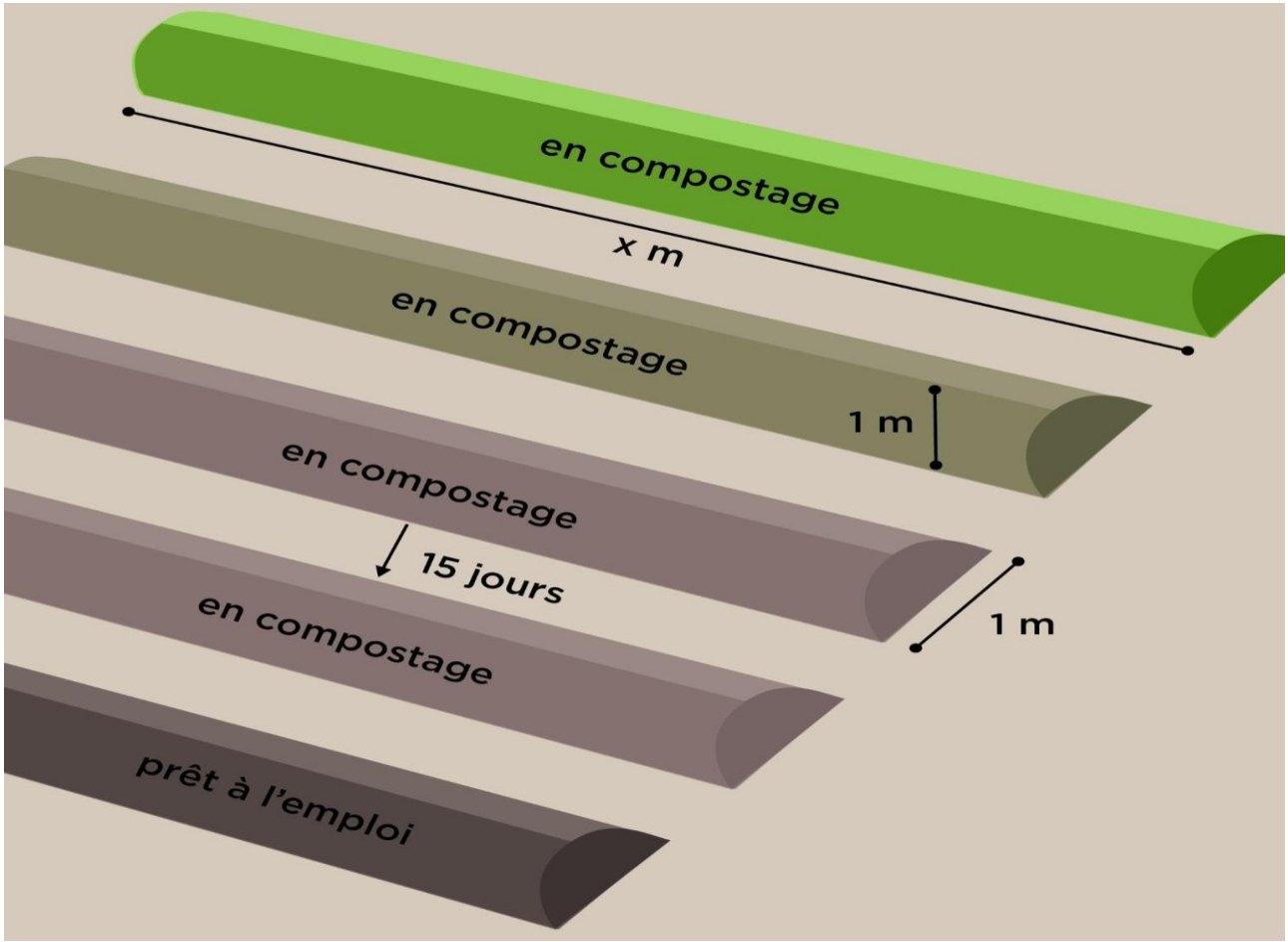
Composting in windrows

Composting creates a fertilizer from plant waste.

- **Valorizes** farm waste
- **Nutrient-rich,** fertilizes soil, nourishes crops
- **Locally produced,** no need to buy from a third party

How do I do it?

- Prepare on **bare soil**
- **Protect** from direct sun or rain
- **1st layer** (15 cm) of chopped banana trunks (5 to 10 cm)
- **2nd layer** (15 cm) of available manure (sheep, goat, cow, pig, no chicken droppings)
- **3rd layer** of eggshells and ashes, covering the entire surface of the ridge
- **4th** (40 cm) dry straw
- **5th** (30 cm) fresh plant matter: crop residues, freshly cleared grass, etc.
- Turn over all layers every **15 days**
- Compost is ready after **2 months**



Green manure

Green manure are plants grown to improve soil fertility.

- **Legumes**: transfer nitrogen N from the air into the soil.
- **Grain legumes**: similar, but also produce edible grains.
- **Grasses**: mobilize soil nutrients (P, Mg, Ca, N) and create biomass (C).

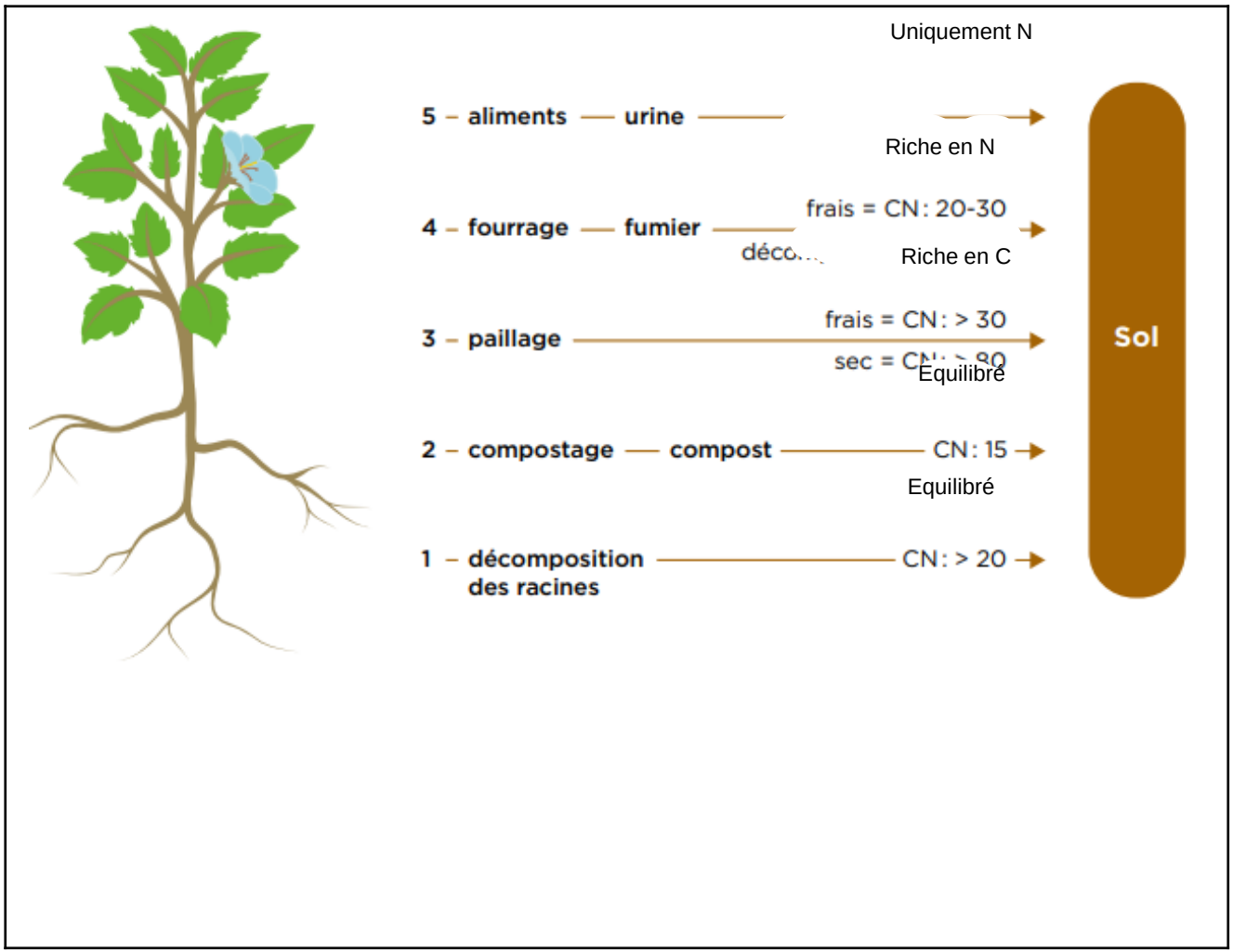
Green manure is grown between crops and used to make fertilizer for the following crop.

How do you make fertilizer from these plants?

They must be decomposed to transfer mobilized nutrients and organic matter to the soil and the crop.

There are **5 paths**:

For forage→ use a mix of legumes + grasses



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Green manures: legumes

Legumes that do not produce edible grain capture larger quantities of nitrogen, which is found in their abundant foliage. They are recommended in rotation to regenerate the soil.

- ***Stylosanthes guianensis/hamata***

Perennial (3 years)

Sowing: 7-12 seeds or cuttings/seedhole 30 to 40 cm between seedholes (2-3 kg/ha)

Excellent dry-season forage for ruminants

- ***Mucuna pruriens***

Creeping annual

Sowing: in seedholes 20-80 cm apart

Ideal as a cover between 2 crops

- ***Desmodium intortum/uncinatum***

Annual

Sowing: in rows 50 cm apart, sow 5 kg/ha, mow every 2-3 months

Pest control in cereals (--> push-pull)

Excellent forage

Fertilization and Soil Protection

Green manures: legumes

- **Cajanus cajan, Pigeon pea**
- Bushy perennial
- Sowing: direct, 35 cm x 35 cm
- Cajan pea can be grown in hedgerows or in association with other crops (maize, cassava).

Others: Azilicarpus, Alfalfa, Arachis pintoi, Lablab, Crotalaria

- **Leguminous trees:**
- Gliricidia, Sesbania, Calliandra, Leucaena, Pois Cajan, Acacia
- In hedgerows around crops or in semi-agroforestry.

- **Grain legumes:** Beans, Peanuts, Cowpeas, Soybeans



- The grains are eaten.
- The roots decompose and enrich the soil.
- Stems and leaves are used as green manure.

Fertilization and Soil Protection

Green manures: grasses

Grasses do not fix nitrogen, but they :

- Restructure the soil (decompacting, etc.)
- Produce a lot of organic matter
- Mobilize soil nutrients (P, Ca, Mg, N)

Pennisetum purpureum

- Erect perennial
- Sowing: in seedholes (8-10 seeds) or cuttings spaced 30-40 cm apart (3-7 kg/ha required, broadcast: 10-20 kg/ha)
- Mow every 2-3 months → forage fresh, grazed or dried and used as hay
- Use to trap cereal pests, can be planted as a barrier between plots.

Brachiaria

- Like pennisetum but adapted to dry climates.

Eleusine coracana

- Eleusine, small millet: annual
- Broadcast sowing (8-10 kg/ha)
- Weed regularly
- Edible seeds
- Mow before heading forage

Others: Panicum, Andropogon, Dasho, Oats

Brachiaria barrier between 2 plots