SUPPORT FOR FARMERS IN SUSTAINABLE SOIL FERTILITY MANAGEMENT IN FRENCH GUIANA

Chapter 1 : Understanding your soil

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CHAMBRE D'AGRICULTURE GUYANE

Avec la contribution financière du compte d'affectation spéciale développement agricole et rural CASDAR

MINISTÈRE DE L'AGRICULTURE ET DE LA SOUVERAINETÉ ALIMENTAIRE
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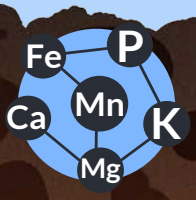
THE AGRONOMIC ROLES OF SOIL

The soil provides nutrients, water, physical support, and favorable conditions for plant growth.

Proper soil management, including **maintaining its fertility**, **preventing erosion**, and **promoting healthy microbial biodiversity**, is essential to ensure sustainable plant production.



PHYSICAL SUPPORT

A well-aerated and structured soil allows roots to anchor and develop properly.

BIODIVERSITY RESERVOIR

It hosts living organisms that decompose organic matter and improve soil fertility.

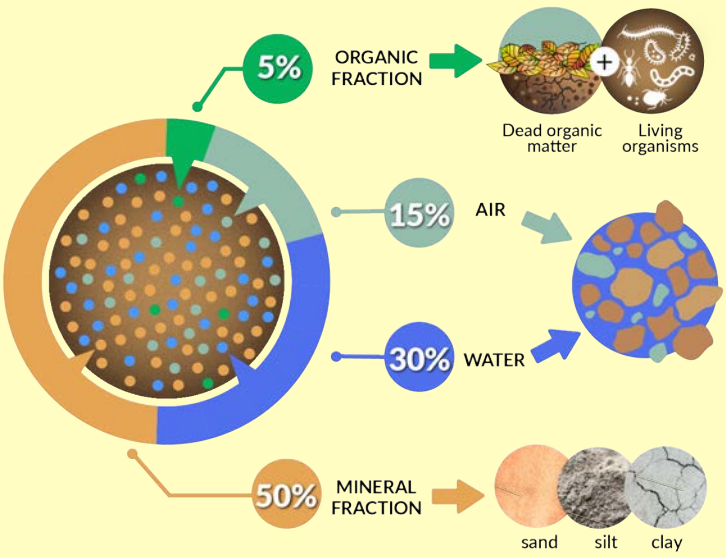
NUTRIENT SOURCE

Soil supplies essential elements, nitrogen, phosphorus, and potassium, necessary for plant growth.

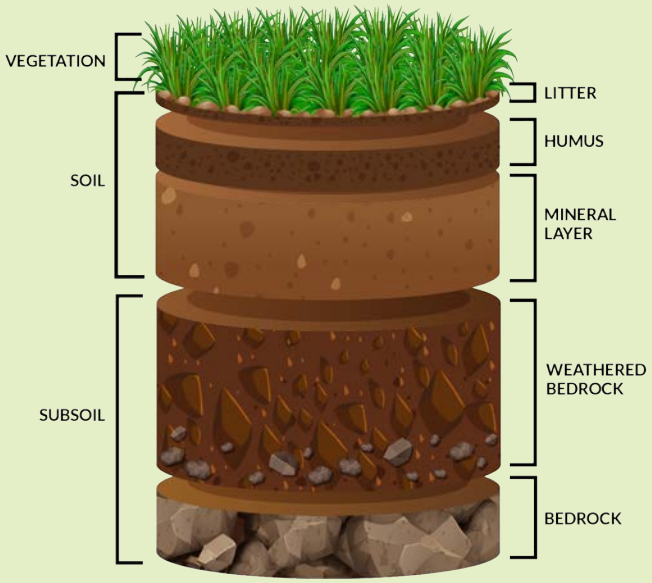
WATER RETENTION

Soil stores moisture and ensures its availability for plants.

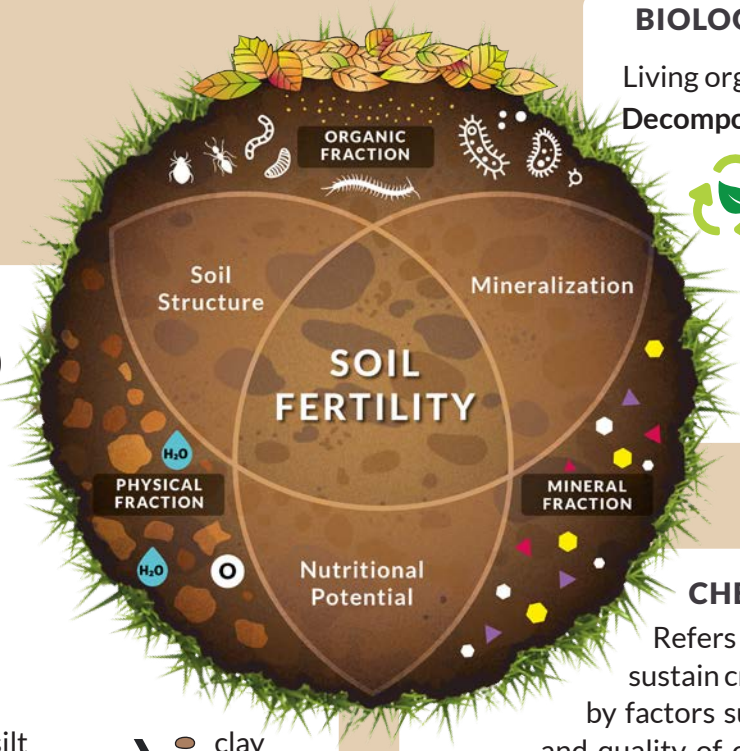
SOIL COMPOSITION



SOIL PROFILE



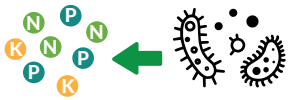
COMPONENTS OF SOIL FERTILITY



BIOLOGICAL QUALITY

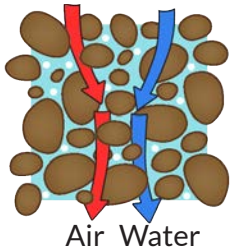
Living organisms in the soil:
Decomposition of organic matter

release of mineral elements for crops



PHYSICAL QUALITY

soil structure (water and air circulation)



Air Water

Arrangement of soil elements as texture

sand (Ø >0,05mm) › silt (Ø 2µm et 0,05mm) › clay (Ø <2 µm)

SANDY SOIL	CLAY SOIL
▪ Good drainage (removal of excess water)	▪ Good water and mineral retention
▪ Significant leaching (loss of mineral elements at depth) ▪ Dries out quickly	▪ Water saturation during the rainy season ▪ Significant soil compaction.

CHEMICAL QUALITY

Refers to the soil's capacity to sustain crop growth, determined by factors such as pH, the quantity and quality of organic matter, and the concentration of essential nutrients.

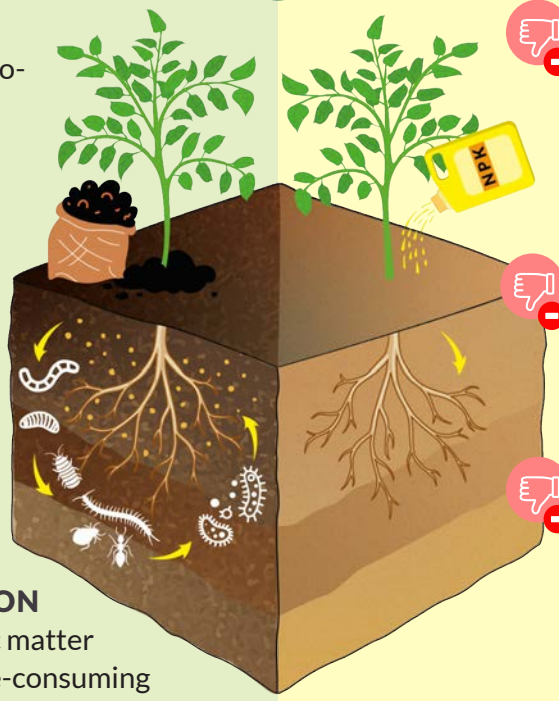
ORGANIC AMENDMENTS VS CHEMICAL FERTILIZATION

RECYCLING YOUR WASTE
Organic waste can be repurposed to benefit your crops.

NUTRIENT PRODUCTION
Provides a natural and diverse supply of nutrients, released gradually according to the characteristics of the organic matter.

IMPROVES SOIL STRUCTURE
Enhances water and air circulation for better root development.

TIME REQUIRED FOR AMENDMENT PREPARATION
Producing or collecting organic matter can be labor-intensive and time-consuming



SOIL POLLUTION
Excess fertilizers can leach into groundwater through runoff, causing pollution known as eutrophication.

SOIL DEGRADATION
- Poor water retention
- Poor retention of nutrients

LOSS OF SOIL LIFE
Without regular organic matter inputs, soil life disappears, disrupting biogeochemical cycles, including mineralization.

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Chapter 2 : Soil Life

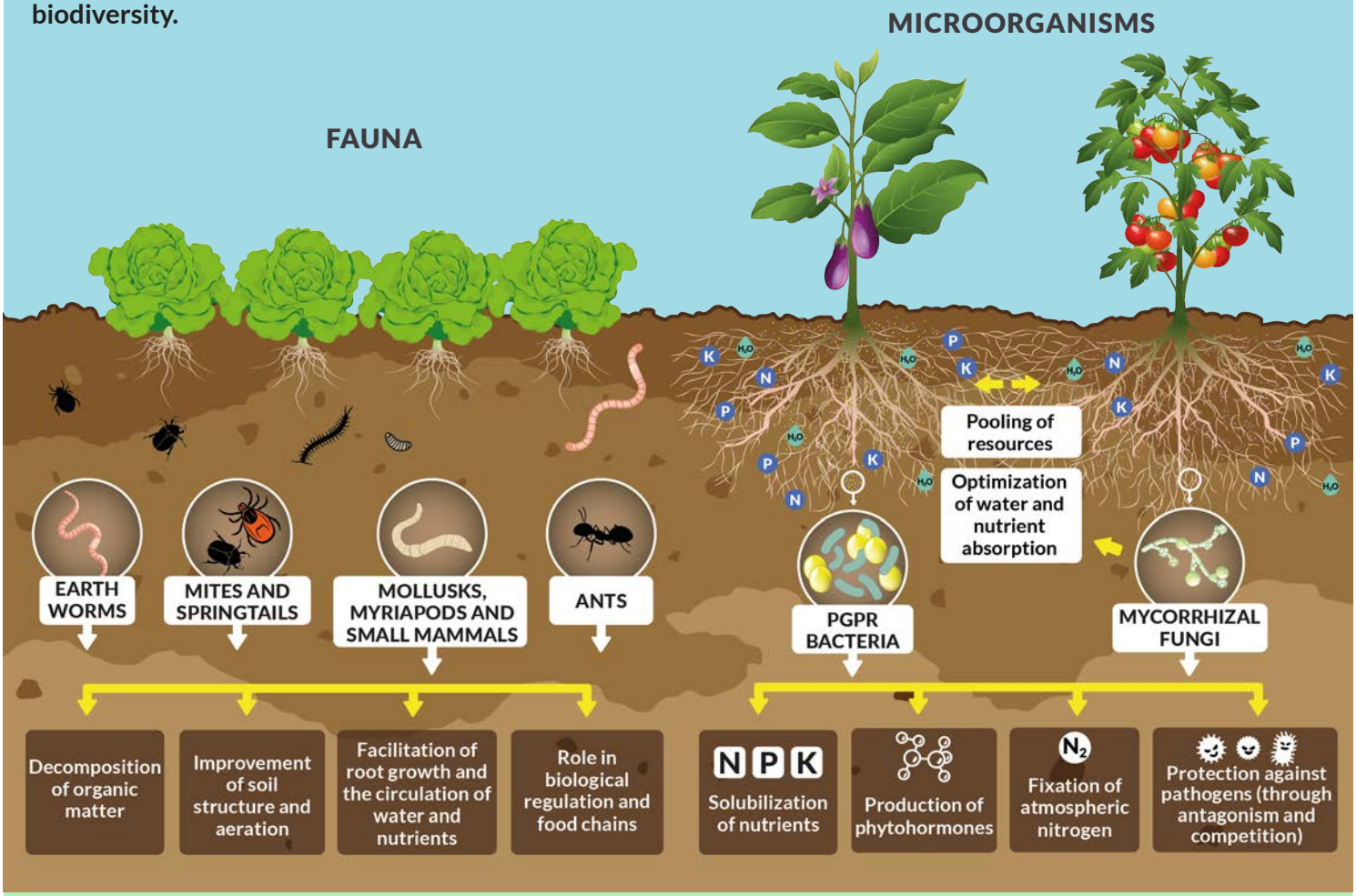
FUNCTIONS OF SOIL BIODIVERSITY

THE RICHEST BIODIVERSITY HABITAT ON EARTH

	Quantity by g or m² of soil	Biomass kg/ha
Bacteria	10^6 – 10^9 /gr	300-3000
Fungi	1 km of hyphae per gram	500-5000
Invertebrates	10^3 – 10^4/m²	500-2000
Earthworms	1 – 4 millions par ha	2000- 3000

Soil is the largest biodiversity reservoir on the planet.

It hosts about **80% of terrestrial biodiversity** and **30% of global biodiversity.**



ADVANTAGES OF LIVING SOIL

NATURAL SUPPLY OF NUTRIENTS

Decomposition of organic matter and release of nutrients for plants.

WATER MANAGEMENT

Improved infiltration, storage, and regulation of water.

PROTECTION AGAINST EROSION

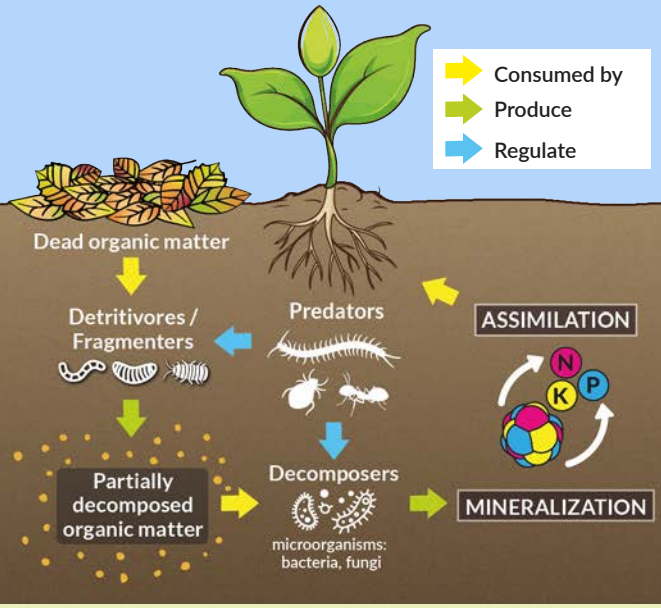
Soil structuring and stability.

CLIMATE REGULATION

Carbon storage and reduction of greenhouse gases.

RECYCLING OF ORGANIC MATTER

Soil organisms play a key role in recycling organic matter. By fragmenting, digesting, and transforming plant and animal residues, they gradually release essential nutrients (nitrogen, phosphorus, etc.) that return to the soil and become available to plants.



PRACTICES THAT NEGATIVELY IMPACT SOIL LIFE

Repeated passage of agricultural machinery compacts the soil, preventing proper circulation of water and air, which are essential for living organisms. It can also cause soil stripping, meaning the removal of the humus layer, the most fertile part.

Leaving soil bare promotes leaching of mineral elements by heavy rains and causes warming and drying of the soil.

Excessive use of chemical inputs and pesticides affects the living communities in the soil.

PRACTICES THAT POSITIVELY IMPACT SOIL LIFE

Adding organic matter (compost, manure, organic amendments, etc.)

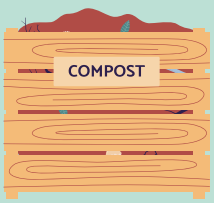
Crop rotation and diversification help prevent soil depletion and diseases, and allow better resource sharing.

Agroforestry, by combining trees with crops, helps protect crops from wind and preserve beneficial fauna.

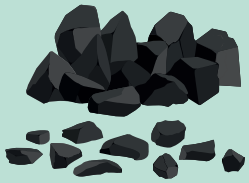
The use of nitrogen-fixing cover plants naturally enriches the soil with nitrogen, improving its fertility and structure.

EXAMPLES OF ORGANIC AMENDMENTS

COMPOST



CHARCOAL



MANURE

chicken, cattle, horse, goat, pig slurry

RCW

Ramial Chipped Wood

BIOSTIMULANTS

plant extracts, amino acids and peptides, humates and organic matter, microorganisms

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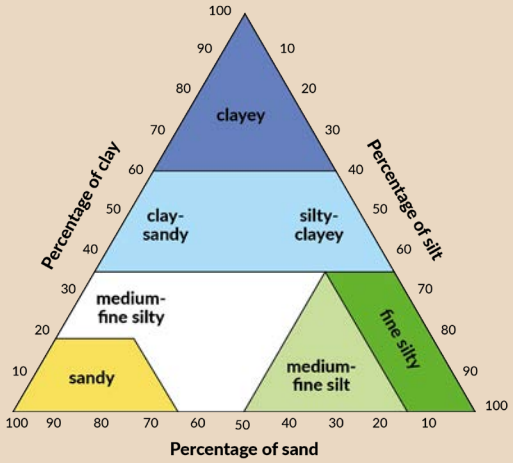
Chapter 3 : Understanding Soil Analyses

PHYSICAL COMPONENT: STRUCTURE AND TEXTURE

sand (Ø >0,05mm) > silt (Ø 2µm - 0,05mm) > clay (Ø <2 µm)

PARTICLE SIZE DISTRIBUTION (GRANULOMETRY)
Distribution of particles according to their size (clay, silt, sand).
IMPORTANCE
- Determines soil structure. - Influences water and nutrient retention capacity. - Affects aeration, drainage, and root penetration.

INTERPRETATION		
Sandy soil: Well-drained, poor in nutrients, low water retention.	**Silty soil:** Balanced but prone to crusting (surface sealing).	**Clay soil:** Good water retention but poorly aerated and hard to work.



BIOLOGICAL COMPONENT: MICROBIAL ACTIVITY

ACTIVE MICROBIAL BIOMASS

Represents the living fraction of soil microorganisms responsible for decomposing organic matter.

IMPORTANCE

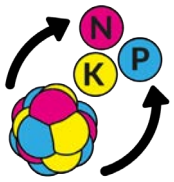
- Measures the soil's capacity to transform organic matter.
- Serves as an indicator because it reacts quickly to agricultural practices (tillage, organic inputs, machinery use, etc.).

INTERPRETATION

Low	Medium	High
Depleted soil, little microbial activity.	Functional soil, but can be improved with organic inputs.	Very biologically active soil, good organic matter recycling.

MINERALIZATION RATE

Quantity of organic matter mineralized by soil microbial activity.



IMPORTANCE

Measures the soil's capacity to naturally release nutrients.

INTERPRETATION

Low	Medium	High
Low activity, inactive soil, microflora not very active.	Balanced activity, good mineralization dynamics, functional soil.	High activity, rapid mineralization, risk of organic matter loss too quickly.

CHEMICAL COMPONENT: MINERAL FERTILITY

ORGANIC MATTER (%)

Fraction of soil resulting from the decomposition of plant and animal residues and acting as a reservoir of nutrients (C, N, P, S, etc.).

IMPORTANCE

- Improves soil structure and stability.
- Nutrient pool for plants through gradual release of mineral elements.
- Energy source for microorganisms.
- Increases CEC (Cation Exchange Capacity) and water retention.

INTERPRETATION

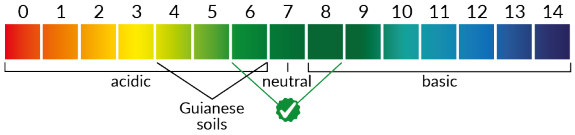
Low	Medium	High
Poor soil, low biological and chemical fertility.	Functional soil, good balance between nutrient storage and release.	Rich soil, biologically active, strong buffering capacity and high resilience.

PH WATER

Measures the actual acidity of the soil.

IMPORTANCE

Indicates the bioavailability of nutrients and evaluates soil compatibility with most crops.



INTERPRETATION

pH > 6	pH 5–6	pH < 5
Neutral to slightly acidic soil, favorable for most crops.	Moderately acidic soil, correct biological activity.	Very acidic soil, risk of phosphorus (P) lock-up and aluminum (Al^{3+}) toxicity.

NUTRIENT ELEMENTS

Essential Mineral Elements for Plant Nutrition Phosphorus (P), Potassium (K), Magnesium (Mg), Sodium (Na), Calcium (Ca)

IMPORTANCE

- These elements reflect the actual chemical fertility of the soil and the availability of nutrients for plants.
- They help assess the need for soil amendments or fertilizers.

INTERPRETATION

Low	Medium	High
Possible deficiency, limited plant growth, imbalances between elements.	Good overall availability, satisfactory balance for most crops.	Significant nutrient reserve, but risk of blockages or antagonisms between elements in case of excess.

C/N RATIO

Ratio Between Organic Carbon (C) and Total Nitrogen (N) in Soil

IMPORTANCE

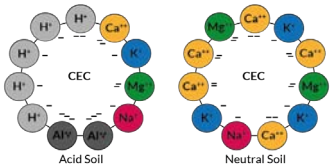
- Indicates the rate of organic matter mineralization.
- Guides management practices for adding organic materials to balance the C/N ratio.

INTERPRETATION

Low	Medium	High
Rapid mineralization, risk of nitrogen loss and crop burn.	Good balance between decomposition and nitrogen availability.	Slow mineralization, risk of temporary nitrogen immobilization (nitrogen starvation).

CEC (CATION EXCHANGE CAPACITY)

Represents the bioavailable reserve of nutrient elements (K^+, Mg^{2+}, Ca^{2+}, Na^+) that the soil can hold and release for plants.



IMPORTANCE

It indicates the soil's capacity to store nutrients.

INTERPRETATION

Low	Moyenne	High
Low nutrient reserve, soil is sensitive to nutrient losses and pH variations.	Adequate reserve, soil can store and release nutrients in a balanced way.	Large nutrient reserve.