

# Soils



## Learning objectives:

1. To define soils
2. To enumerate soil functions, profiles and characteristics
3. To discuss soil fertility
4. To explain the sustainable soil management



## Topics covered

- Overview of soil health / land degradation
- Knowing the soil
- Soil functions
- Soil fertility / life
- Sustainable soil management



# Soils on Earth

- Planet Earth surface - 30% land, 70% water
- Yet plays a pivotal role in the existence of humans on earth
- It is important that we understand our soil and make sure it is there for future generations

*“A nation that destroys its soil destroys itself”*

(Franklin D. Roosevelt)

*“To forget how to dig the earth and tend the soil is to forget ourselves”* (Gandhi)





2050

## THE CHALLENGE

global population



will exceed **9 billion**



**increased  
demand for healthier  
and nutritious food**  
will only be met if



**agricultural  
production**  
increases

 **60%**  
globally

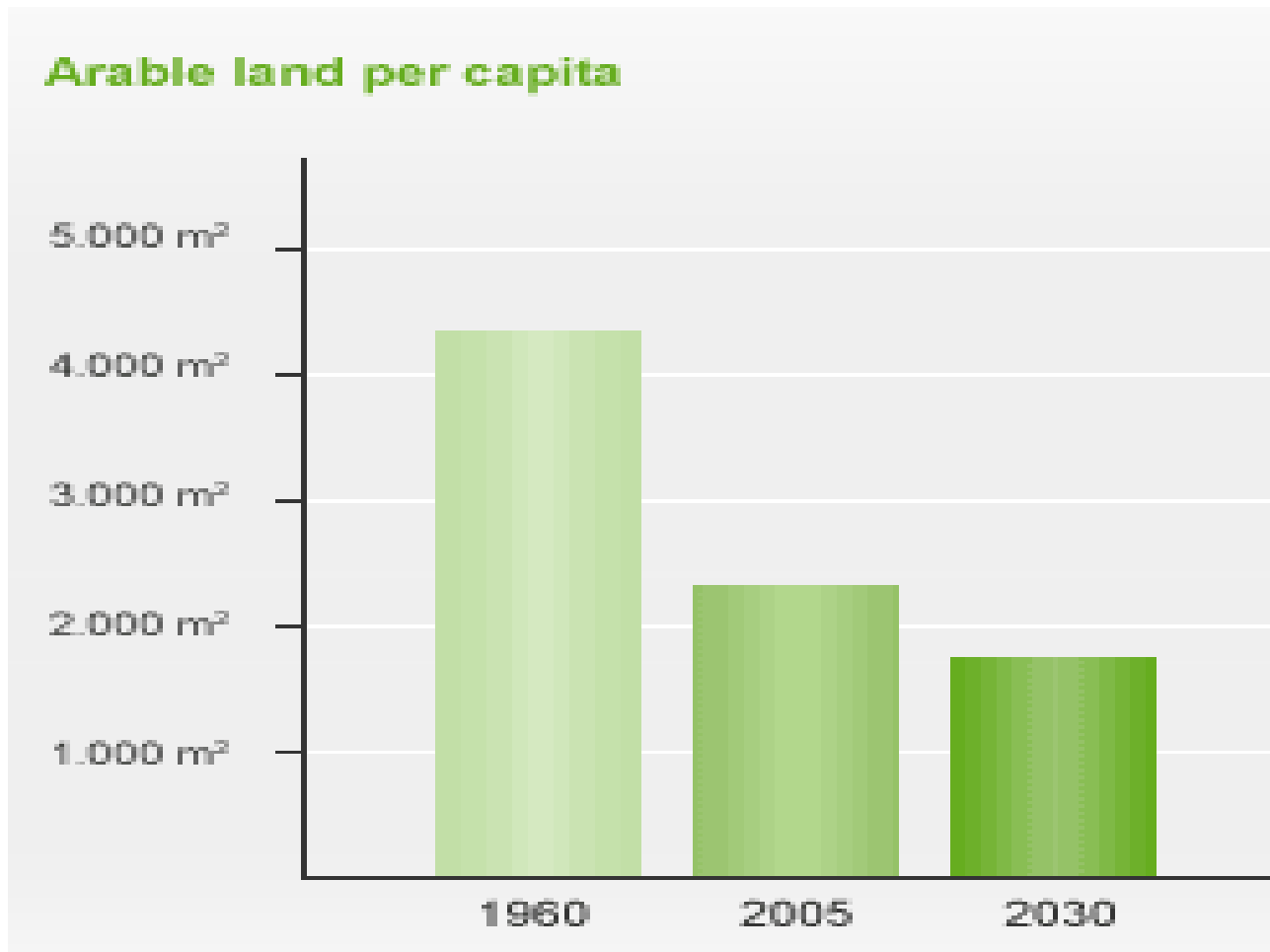
 **~100%**  
developing  
countries



**Soils are  
under pressure  
of intensification  
and competing uses of**  
forestry, cropping,  
pasture & urbanization

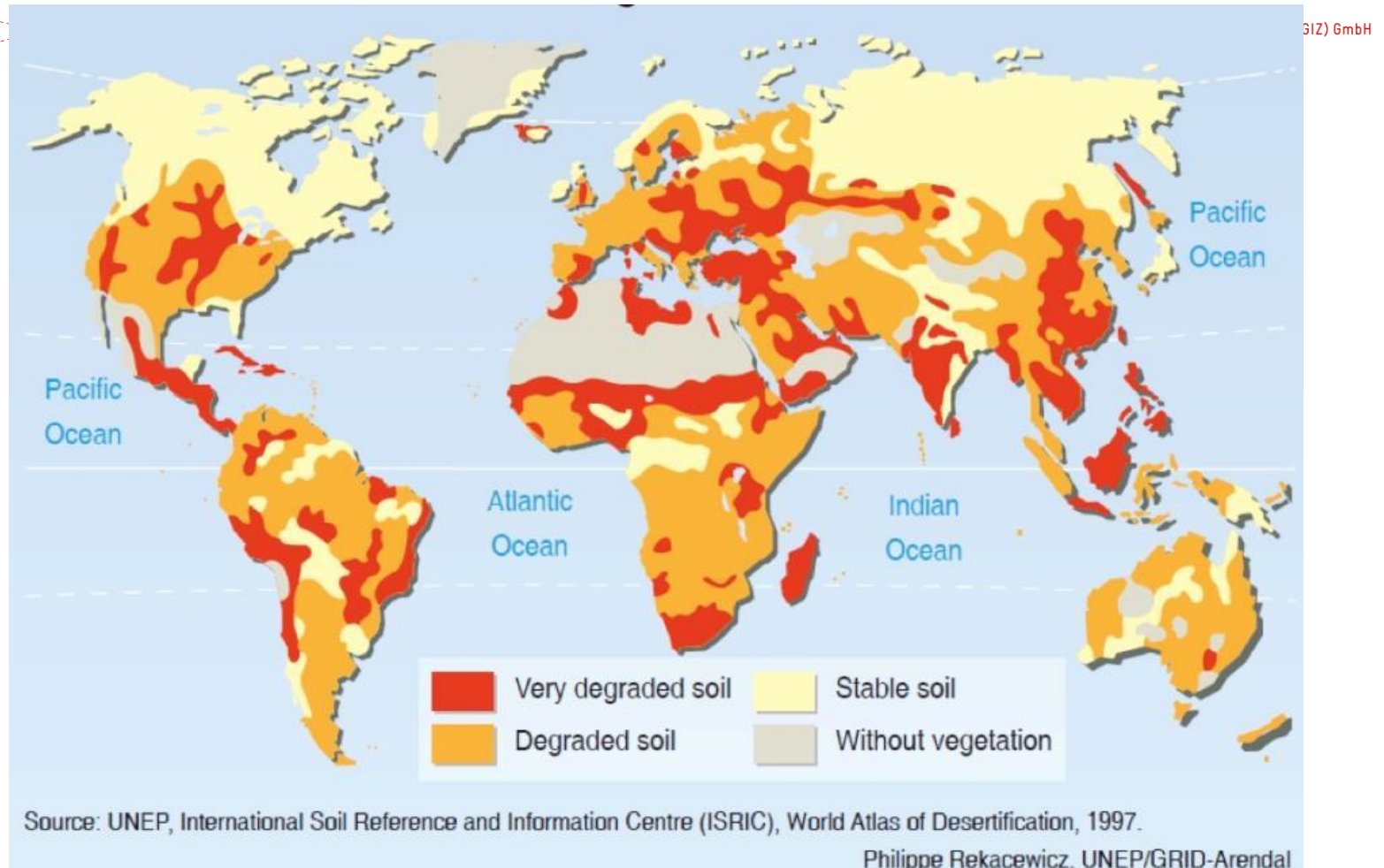


## Soils are getting scarce



**FAO Infographic 2015**

# Alarming rates of land degradation



- Many of our soils are becoming damaged and are at risk
- Caused by soil erosion (water/wind), salinization, soil compaction, contamination by chemicals etc.



## Let's talk about soil

<http://globalsoilweek.org/resources/video-lets-talk-about-soil>





## Knowing your soil...

### ➤ What is soil?



- The upper part of the earth's surface on which we live and from which we get the very basic needs, and together with air and water it is the basis for life.
- Soil is the foundation for biodiversity.
- 2015 has been declared as the International Year of Soils by the UN.  
Theme: Healthy Soil for a Healthy Life

# Soil



- is a living ecosystem – in which millions of living creatures live and interact
- a “thin carpet” – less than 3m thick
- is formed very slowly by the breaking down of rocks and organic matters by physical, chemical and biological processes
- Chemically has four main components: minerals, organic matter, water and air
- has different functions & properties





# Soil functions

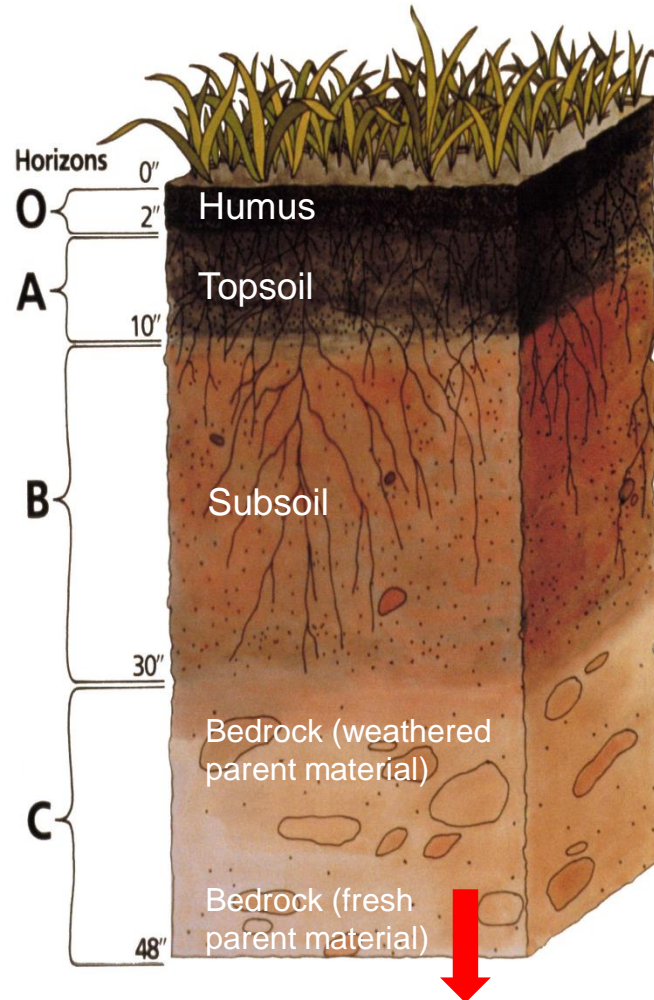
1. For **supporting ground** crops, plants and trees in the wild, on the farm and our gardens
2. As a **home** of various organisms (millions of them)
3. As a **filter** removing pollution from drinking water and regulate the flow of water through the landscape (most rainwater ends up moving into the soil before it gets to plant roots, the aquifers or the river.
4. The **foundation** of our buildings and roads – the types of soil affects how building are made
5. In **preservation of earth's history** – archeological finds are dug from the soil
6. **Modifying** the effects of climate change.

Eg: soil organic matter capable of acting both as a source and sink of carbon

Soils also helps regulate other greenhouse gases such as nitrous oxide and methane



## Soil horizons and profiles ....



## .... Soil characteristics

- Texture
- Colour
- Structure
- Moisture / water retention
- Humus / Organic matter
- pH Value

# Soil characteristics

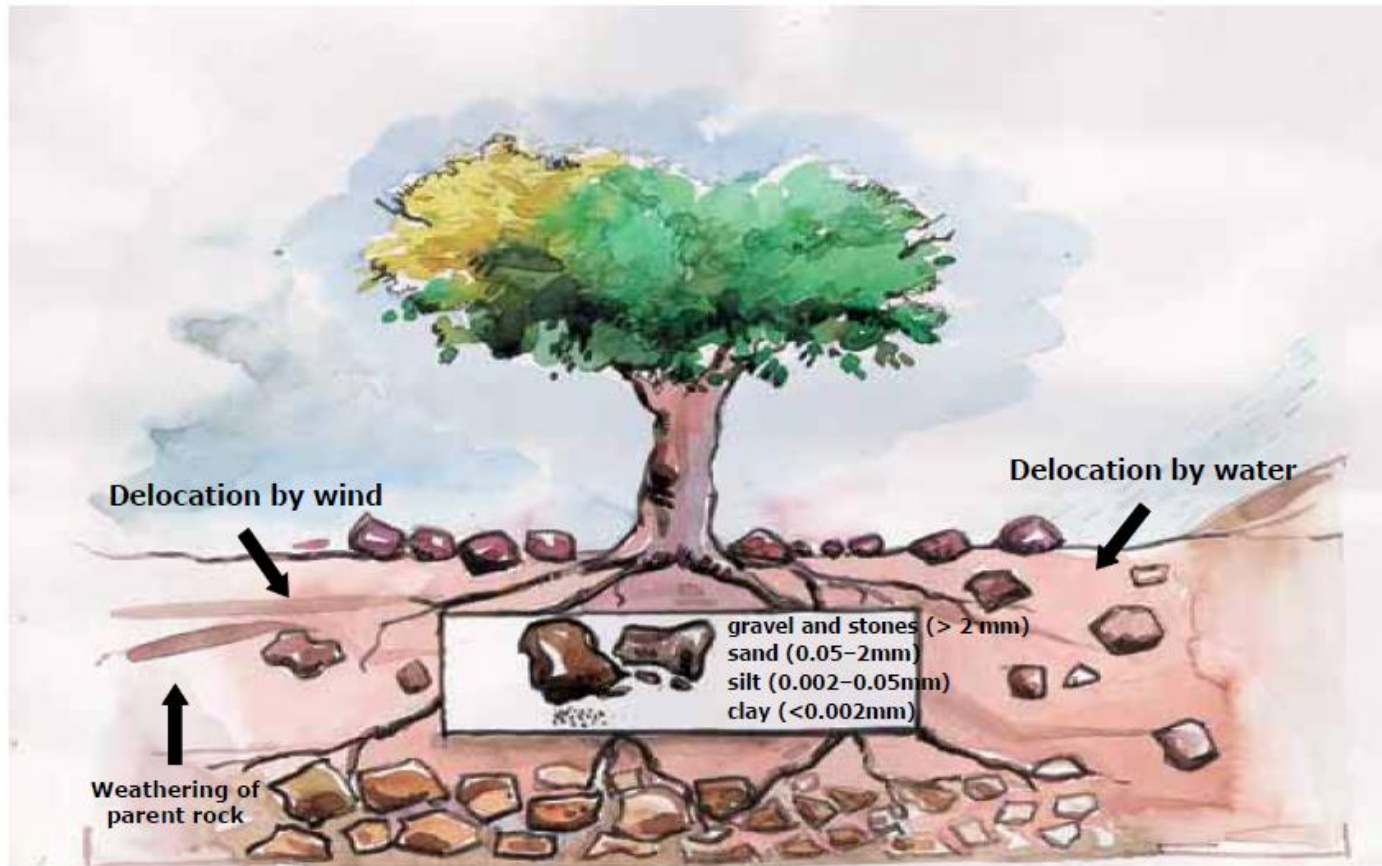


The characters and make-up of the soil play an important part in the behaviour of soils and what they are used for...

- **Soil texture** – an expression used to describe the physical components of the soil (what soil are composed of) such as sand, silt, clay, organic matter
- **Soil structure** – is the way these individual particles are assembled and bound into group (aggregates), which when stuck together with organic matter and other natural mortar to make up the architectural structure of soil
- **Soil colour** can affect its temperature. Darker soils (warm soils) absorb heat more than light coloured soils
- **Soil moisture/water retention** is essential for plant growth. The amount of water a soil can hold depends on the humus content, its texture (sandy, silty, clayey or loamy) and its structure. Soils rich in humus and clay soils can hold more moisture. Sandy soils have low retention properties
- The chemistry of the soil also very important – to determine what and how well it will grow – **pH, CEC**
- **Humus / Organic matter?**



## Texture - Mineral particles

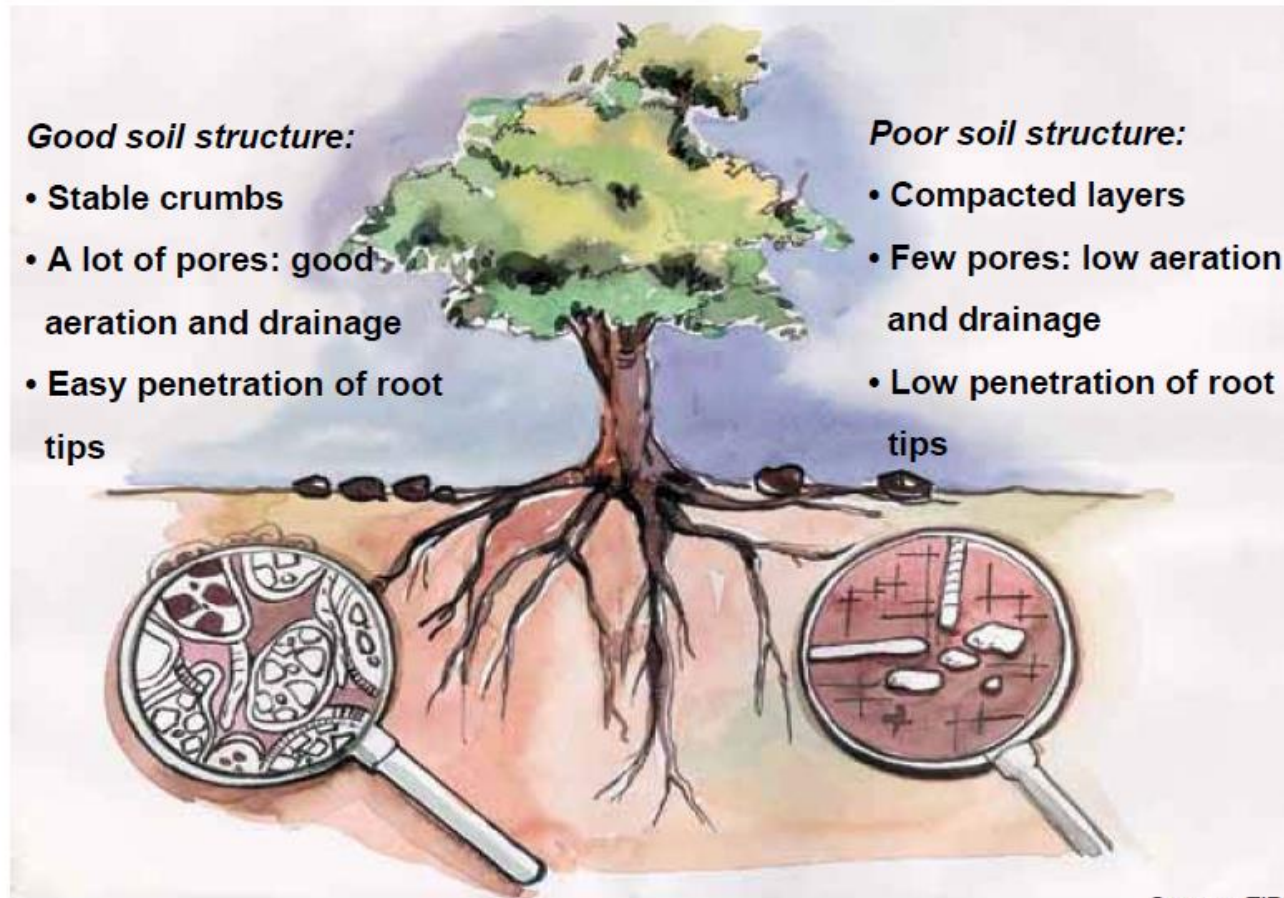


Source: FiBL / IFOAM

- The basis of the soil are its mineral particles. They originate from weathering of parent rock, which is a slow but continuous process as long as parent rock is present
- Water and wind relocate soil from one place to another - as soil erosion or as accumulation of soil in depressions

# Soil structure – What does it mean?

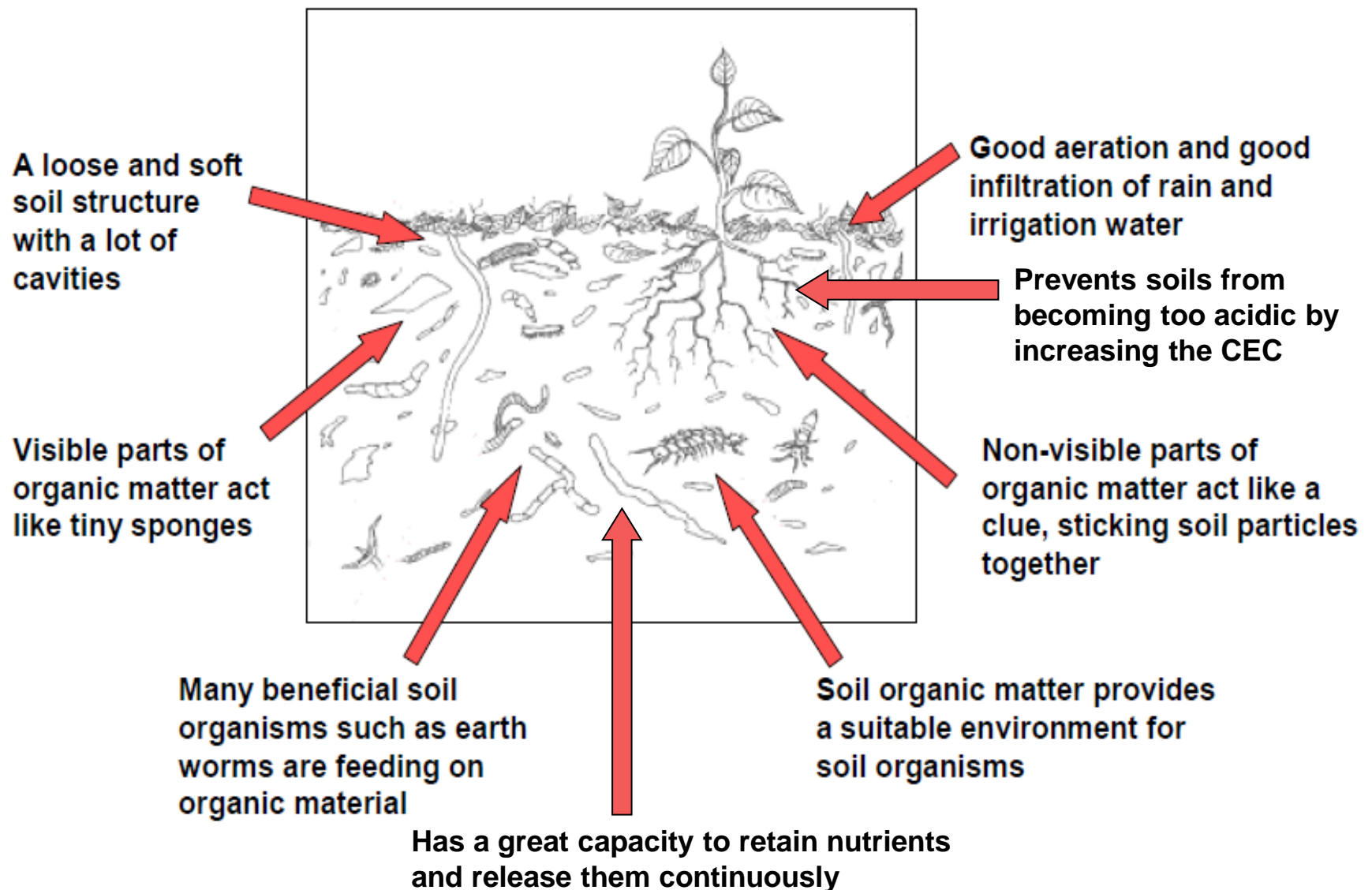
GmbH



Source: FiBL / IFOAM

- Soil structure means the spatial arrangement of the soil components, i.e. the mineral particles and the pores filled with air or water, into crumbles, blocks etc.
- The graphic indicates what is meant by good soil structure (left) and poor soil structure (right)

# Why is organic matter so important?



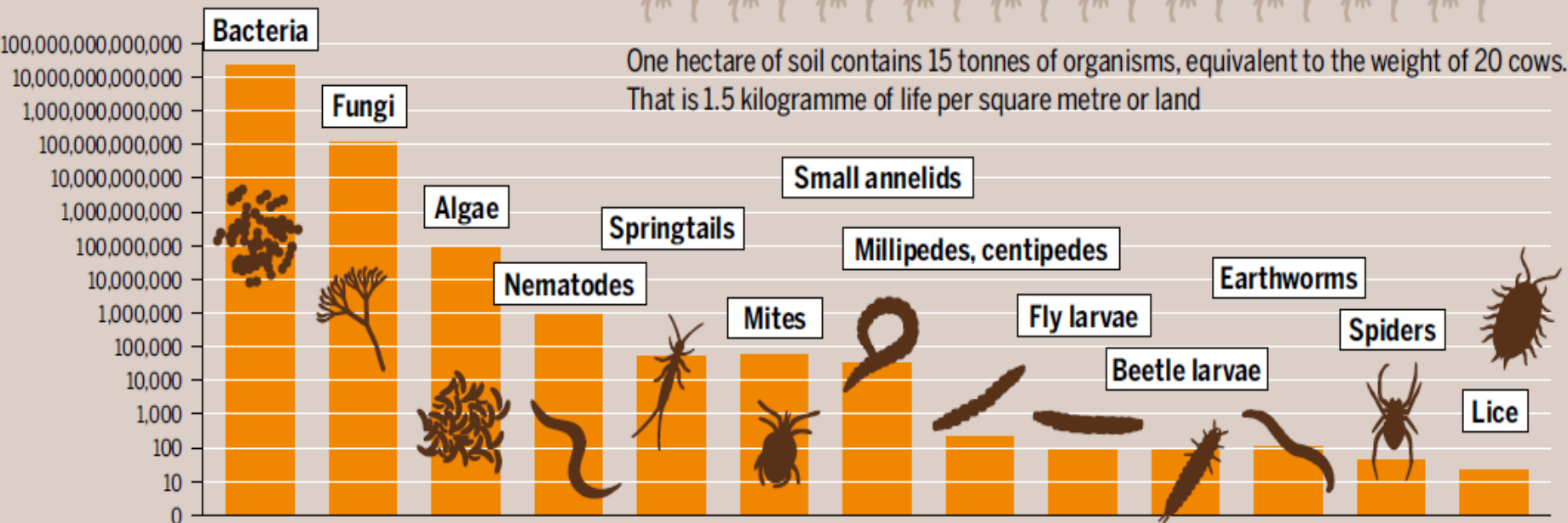




## Some idea about number of organisms per m<sup>3</sup> of topsoil?

### TEEMING SOILS

Number of living organisms in 1 cubic metre of topsoil  
in temperate climates, logarithmic scale



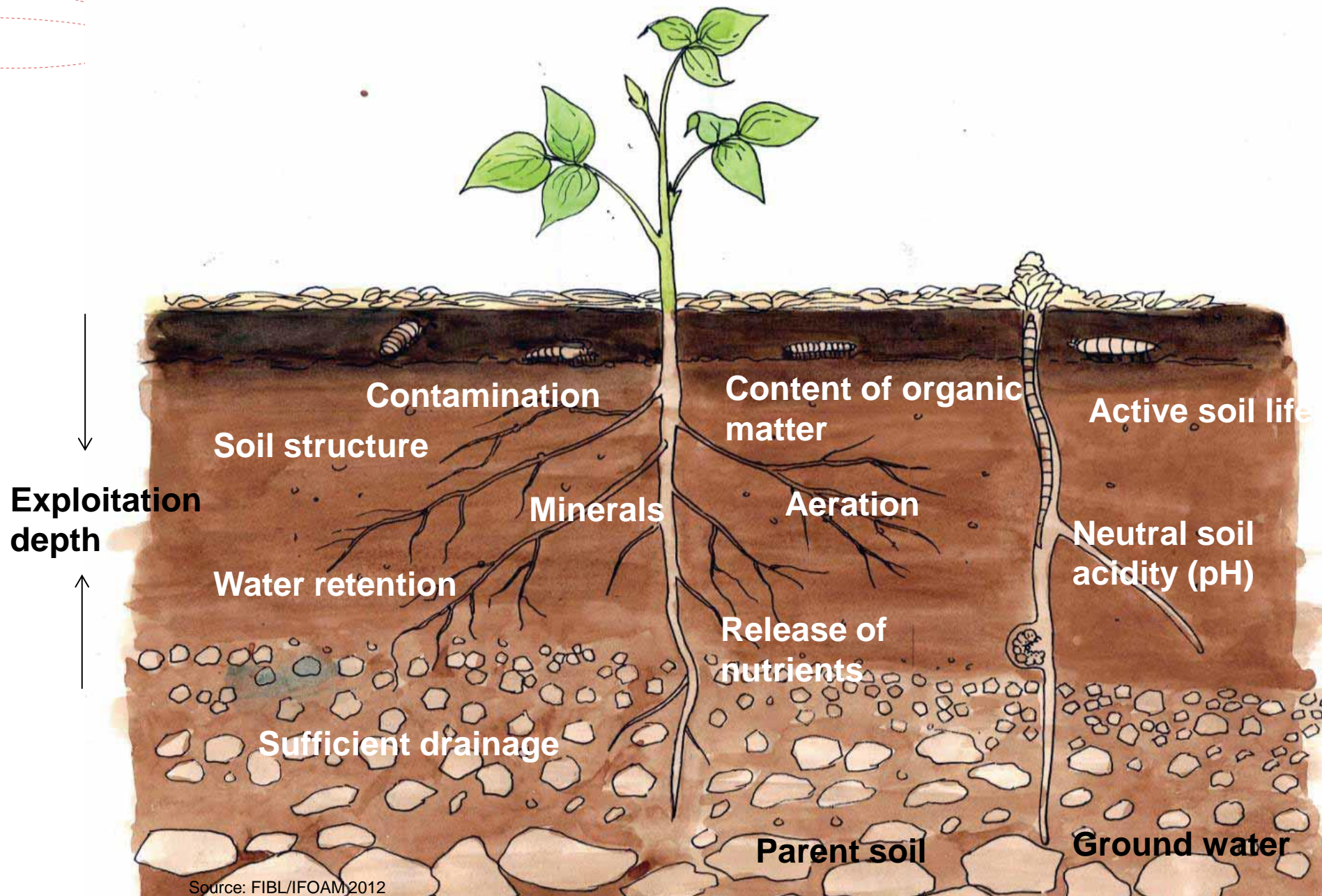
**Soil fauna plays a crucial role for soil fertility. Most of them are very useful, only few cause damage to crops**



## Management requires knowledge - Which factors are responsible for land degradation?

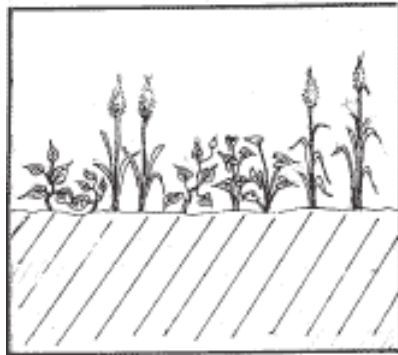
- Soil erosion by water and followed by wind
- Soil salinization through in-appropriate irrigation (?)
- Soil compaction due to animal pressure or due to improper tillage practices
- Reduce of soil bearing capacity especially in the wetland paddy fields
- Soil contamination by chemicals
- Agricultural overuse and misuse lead to nutrient depletion and destruction of soil properties
- In dry land areas in particular, the end result can be desertification

# Factors influencing soil fertility

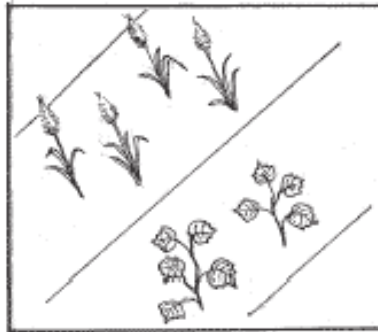




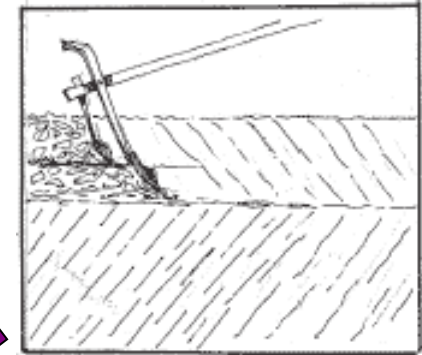
## How to improve and maintain soil fertility



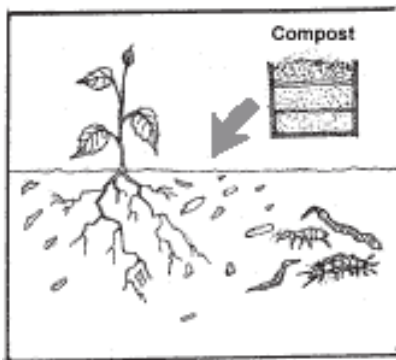
Protection of the soil  
through plant cover



Balanced crop rotation  
or mixed cropping

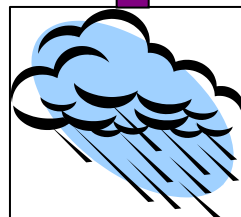


Appropriate tillage

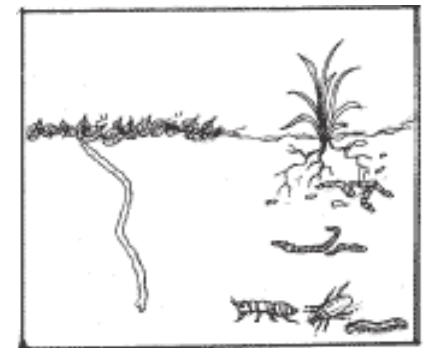


Good nutrient  
management

**A rich and active  
soil of high fertility**



Good water management



Balanced feeding and  
protection of soil organisms





## How to produce more biomass to increase soil organic matter?

- Animal manure
- Composting of manure and plant residues
- Soil covering legumes (mixed cropping / intercropping)
- Green manure crops
- Crop rotation and crop diversification
- Agro-forestry systems

*Grevillea robusta*  
Popular in agroforestry

Mixing with animal manure, palm oil  
mill effluent (POME), effective  
microorganism (EM) and compost



Recycling of paddy straws to the soil  
to maintained the soil fertility status





# How to produce more biomass to increase soil organic matter?

Intercropping system of  
coconut - cocoa



Rice straw mulching



Empty Fruit Bunch and cover  
crops on young oil palm



*Arachis pinto* as cover crops  
in pitaya farm



Intercropping system of  
oil palm - pineapple





## The use of mulching

### Mulching ....

- Reduces erosion
- Maintains soil structure
- Reduces evaporation
- Encourages soil fauna
- Suppresses weeds
- Reduces soil overheating

Paddy straws as mulching layer







## The need for a sustained soil

“We are using the world’s soils as if they were inexhaustible, continually withdrawing from an account, but never paying in. For it takes several thousand years to build a thin layer of fertile topsoil, but only an hour of heavy rain to lose it”.

Source: Soil Atlas 2015

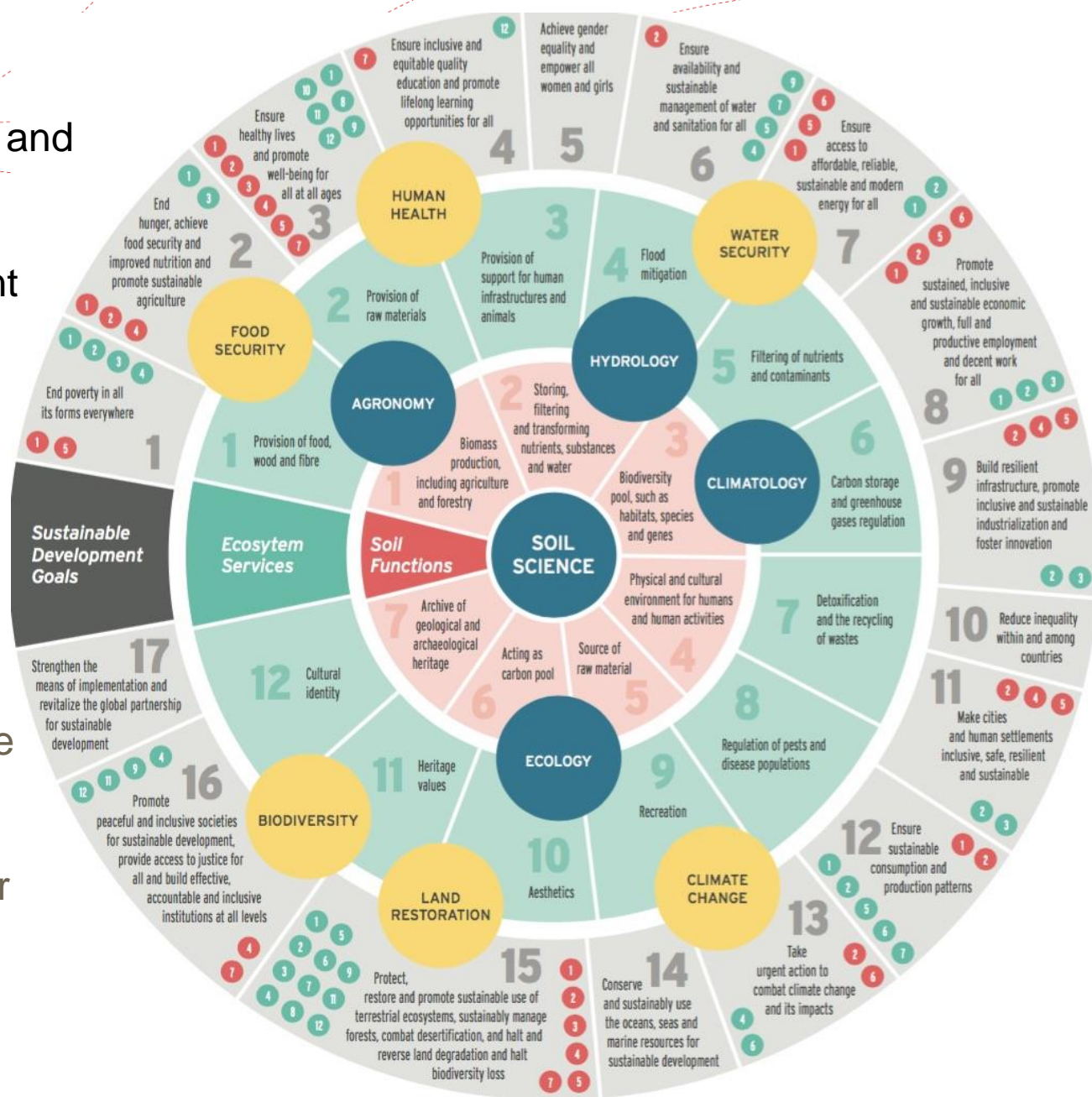
Do not spend your savings all at once, save it!

Build your soil good - increase soil health instead of mining for higher profitability



# Soil science and the UN Sustainable Development Goals

Please refer to the word document to project better this slide



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