PROVISION OF ECOSYSTEM SERVICES BY SOIL RESOURCES: could we account them?

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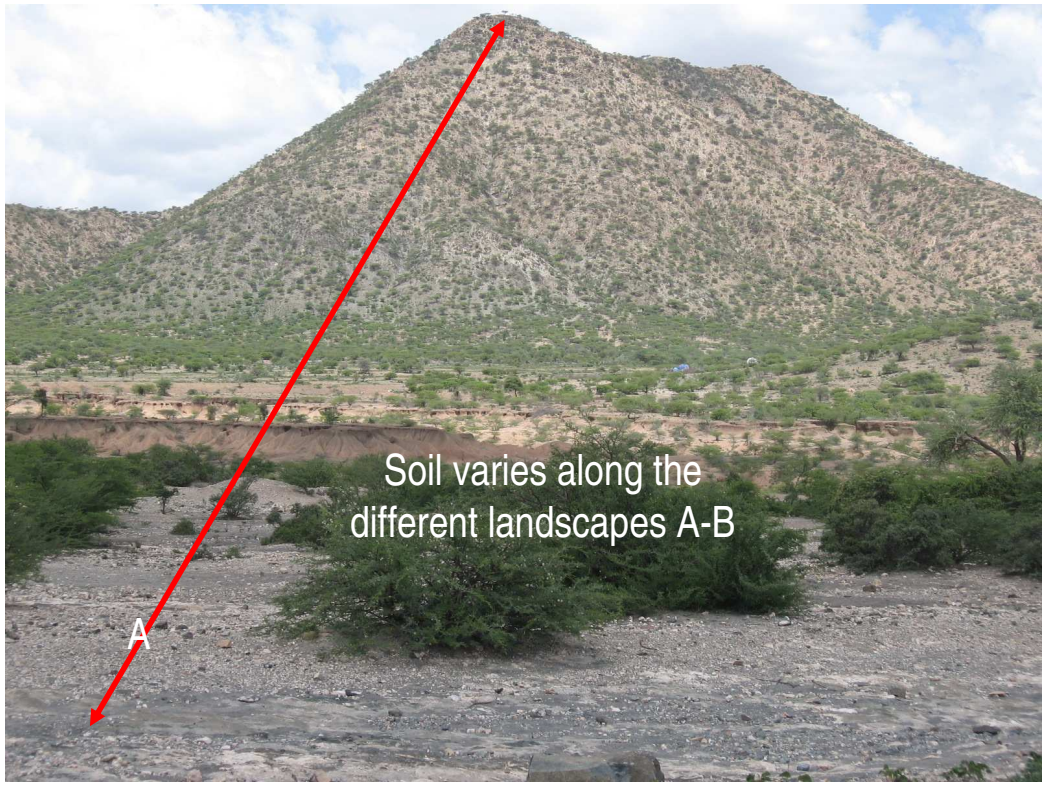
GLOBAL SOIL PARTNERSHIP

What's Soils?

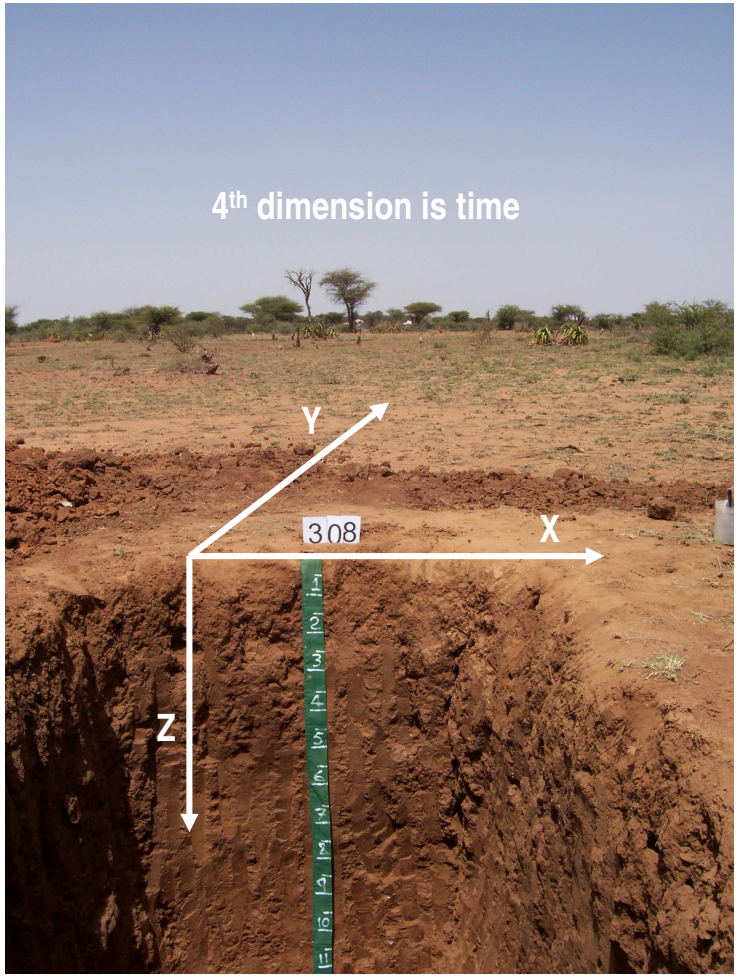
"Soil is the material composed of mineral particles and organic materials that overlies the bedrock and supports the growth of rooted plants".

"Soil is an independent natural body having its own independent morphology resulted from the combination of climate, parent material, biological activities, topography and time" (Dokuchaev, 1885).

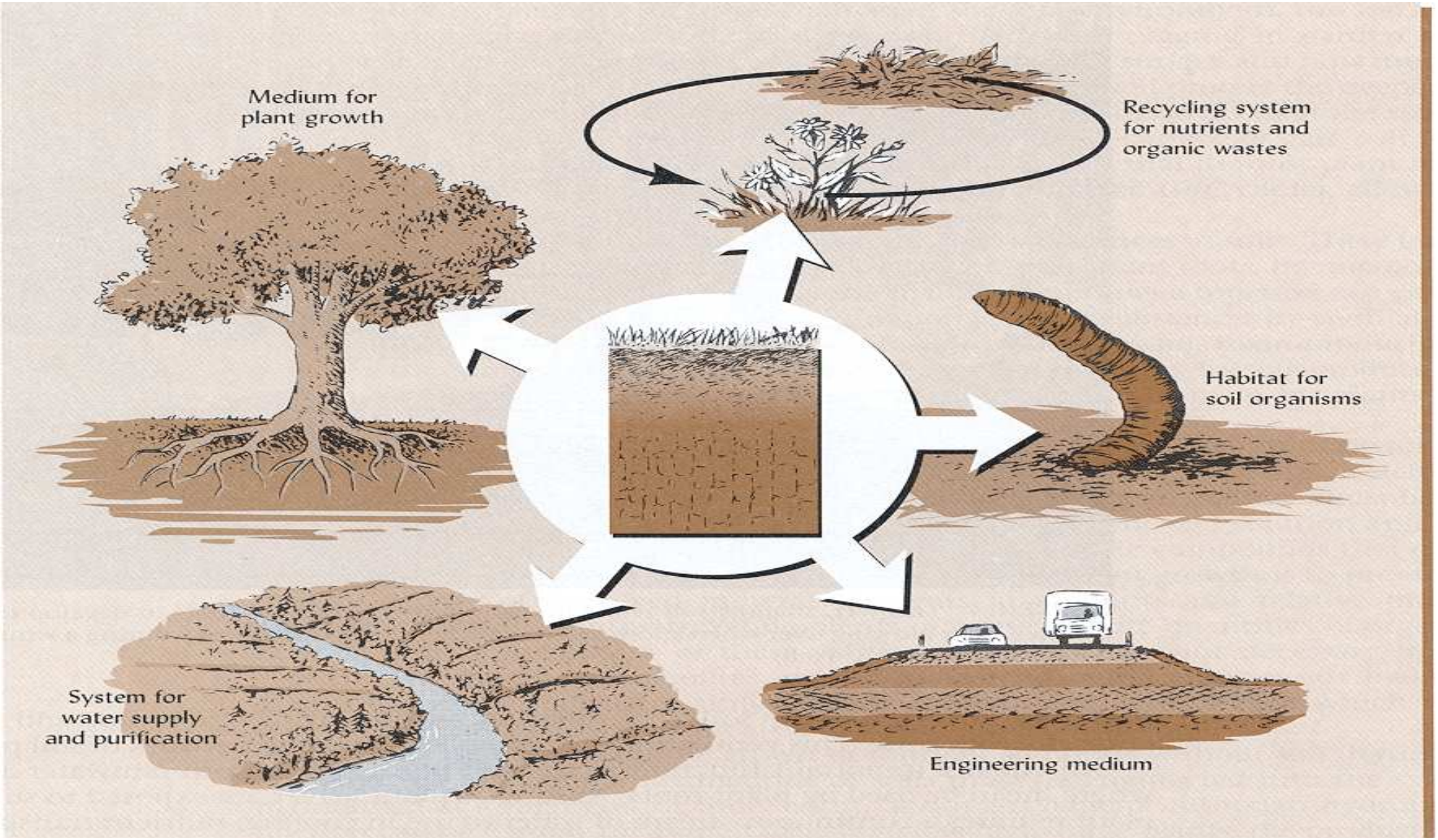


What's Soils?

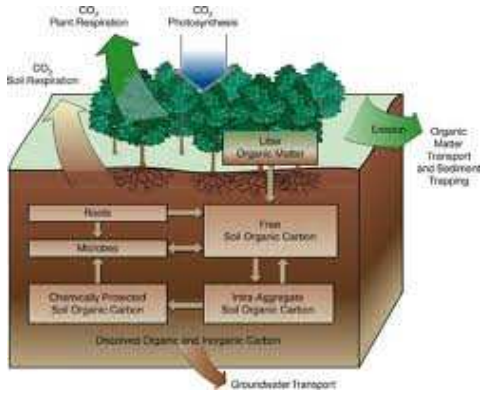
"Soil is considered an heterogeneous fourth dimensional body that is continuous along the landscape".



Functions of Soils



Why Soils?



- **Soils are “living containers”: (inside the soils)**
  - **<u>Water</u> that they regulate (absorbtion, release, cleaning)**
  - **<u>Carbon sinks</u> : highest sink after forest**
  - **<u>Microbiodiversity</u>: 1 cm3 of soils :1 million bacteria, 1 ha of pasture 1 millions earthworms, several millions insects.**

- **human life totally dependant on availaibility of (good) soils *(civilisation collapse factor)***

- **Soils: the most essential and most hidden resource of mankind !**

Ecosystem Functions of Soils

Supporting services
Nutrient cycling, water release/retention, soil formation, habitat for biodiversity, exchange of gases with the atmosphere, degradation of complex materials

Provisioning services:
food and fibre production, water availability, platform for construction

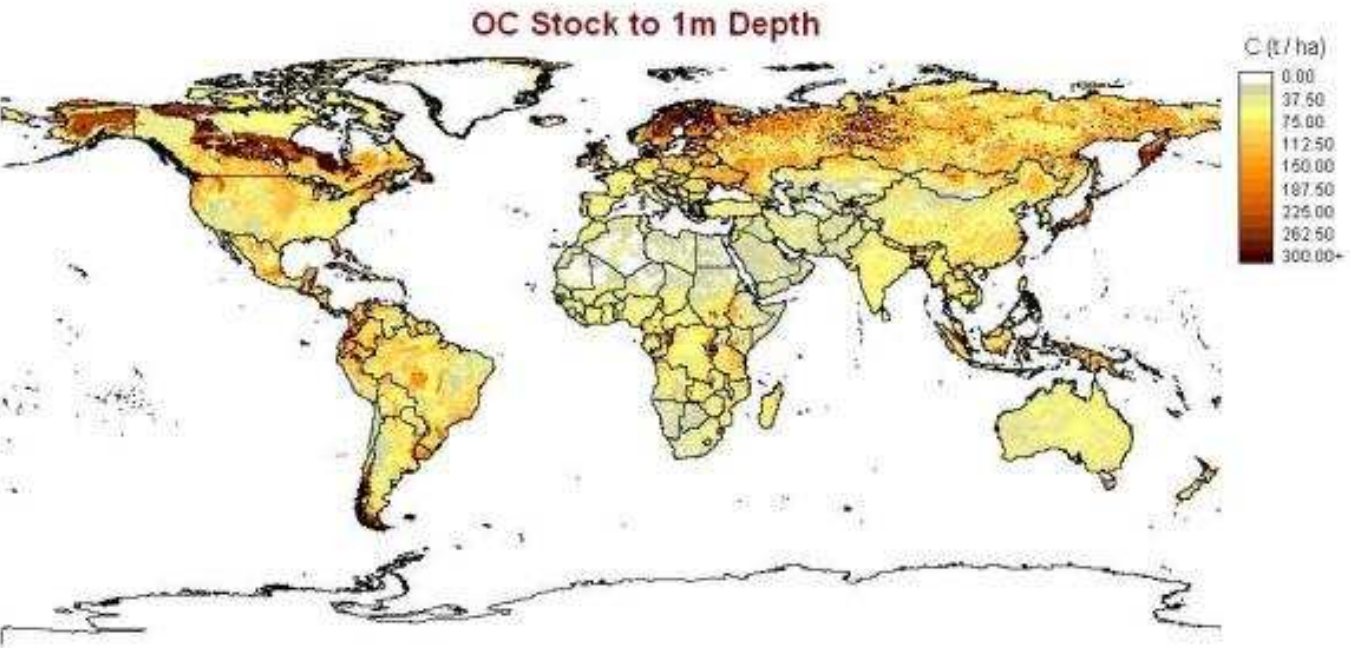
Regulating services:
carbon sequestration, greenhouse gas emissions, water purification, natural attenuation of pollutants

Cultural services:
protection of archaeological remains, outdoor recreational pursuits, landscapes, supporting habitats

(Source: Black2011)

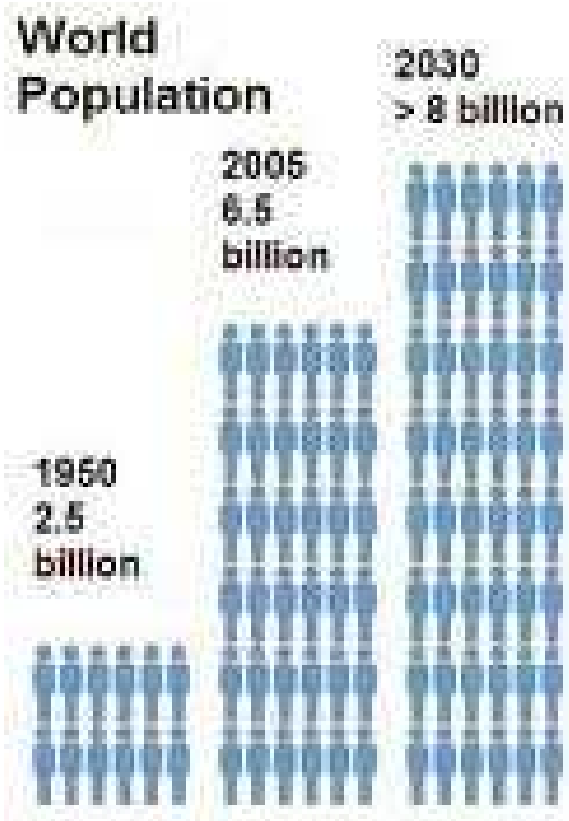
Why Soils are important again?

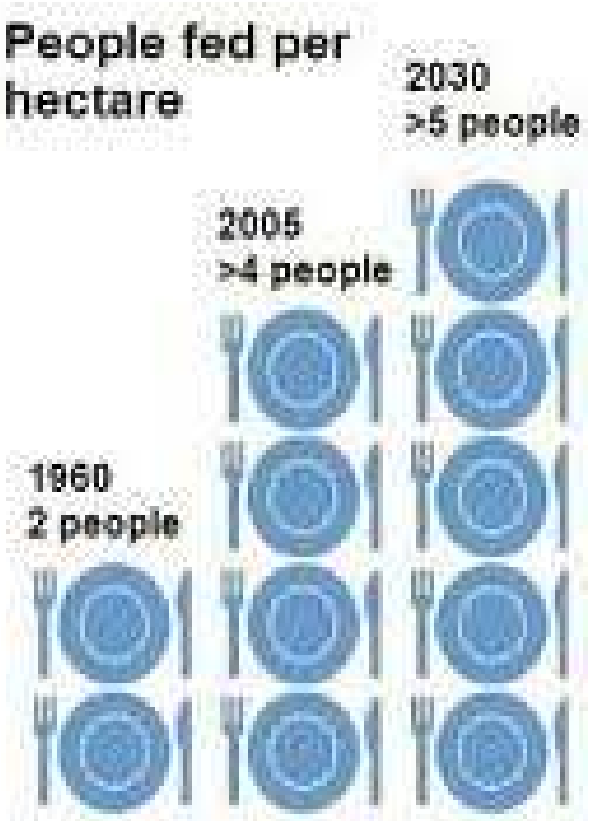
- Carbon sequestration by soils to mitigate and adapt to climate change is one of the main reasons for putting soils in the agenda again.



Why Soils are important again?

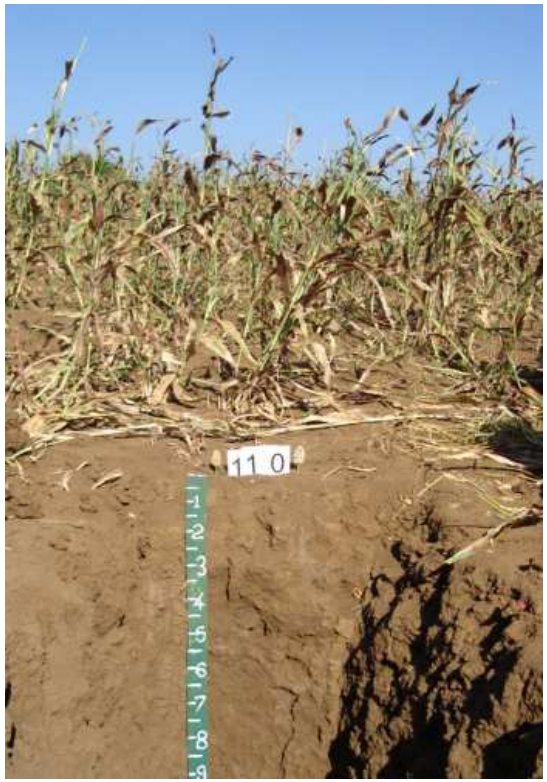
- Growing population demands more ecosystem services provision, especially on regards to food security.





Why Soils are important again?

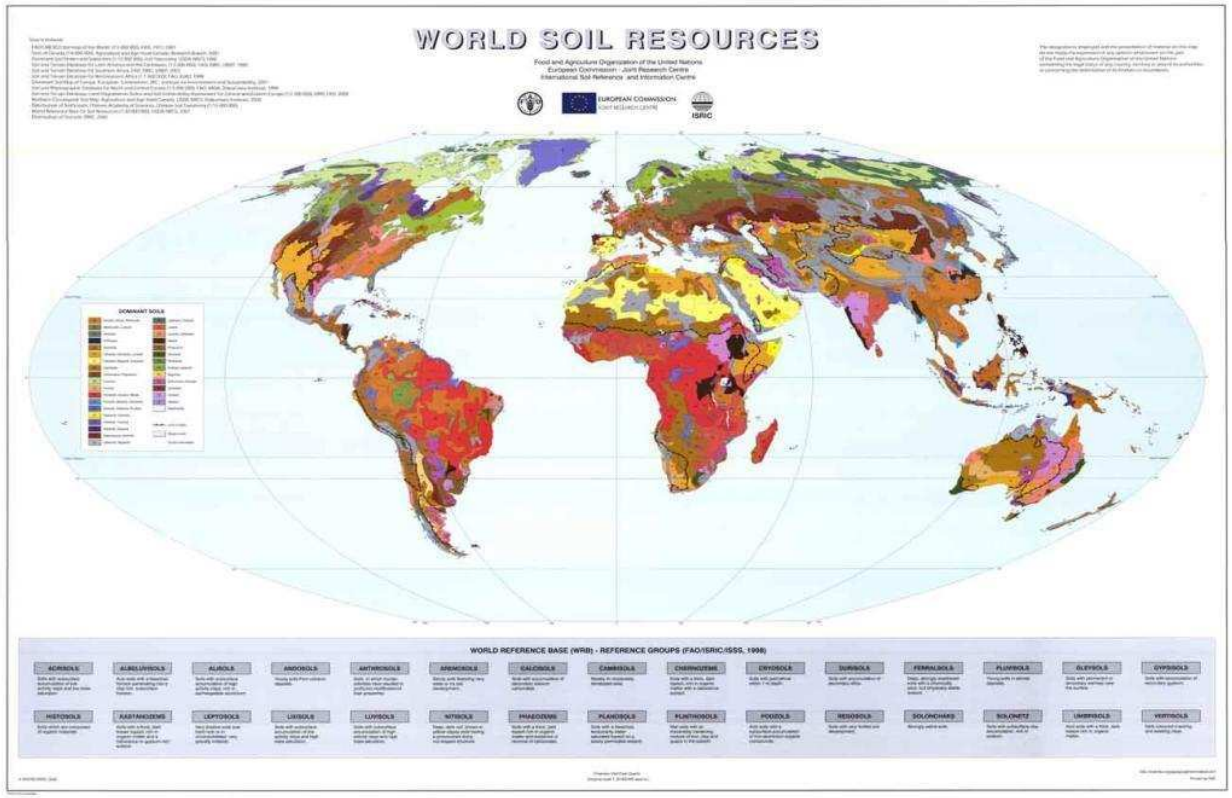
- Soils are a very strategic resource serving for producing food, fiber, fodder, recycling water, sustaining buildings, sequestering carbon and so……. Soils are very variable as per the regions and all have their potentials and limitations. This in fact is the challenge for soil scientists: soil management.



- Soils are being degraded and are less productive - urgent need protection and sustainable management. E.g. Worldwide 24 billion tons of fertile soil disappears each year (UNCCD, 2011). Just in Somalia, an average of 100 tons/ha of topsoil per year is lost (SWALIM, 2009).
- At the same time, in order for nature to **form 2-2.5 cm of soils, requires 1000 years**.

What are the problems with Soils?

- **Soils are complex and non renewable: many soil classes (mineral and biological complex, ecosystem specific).**

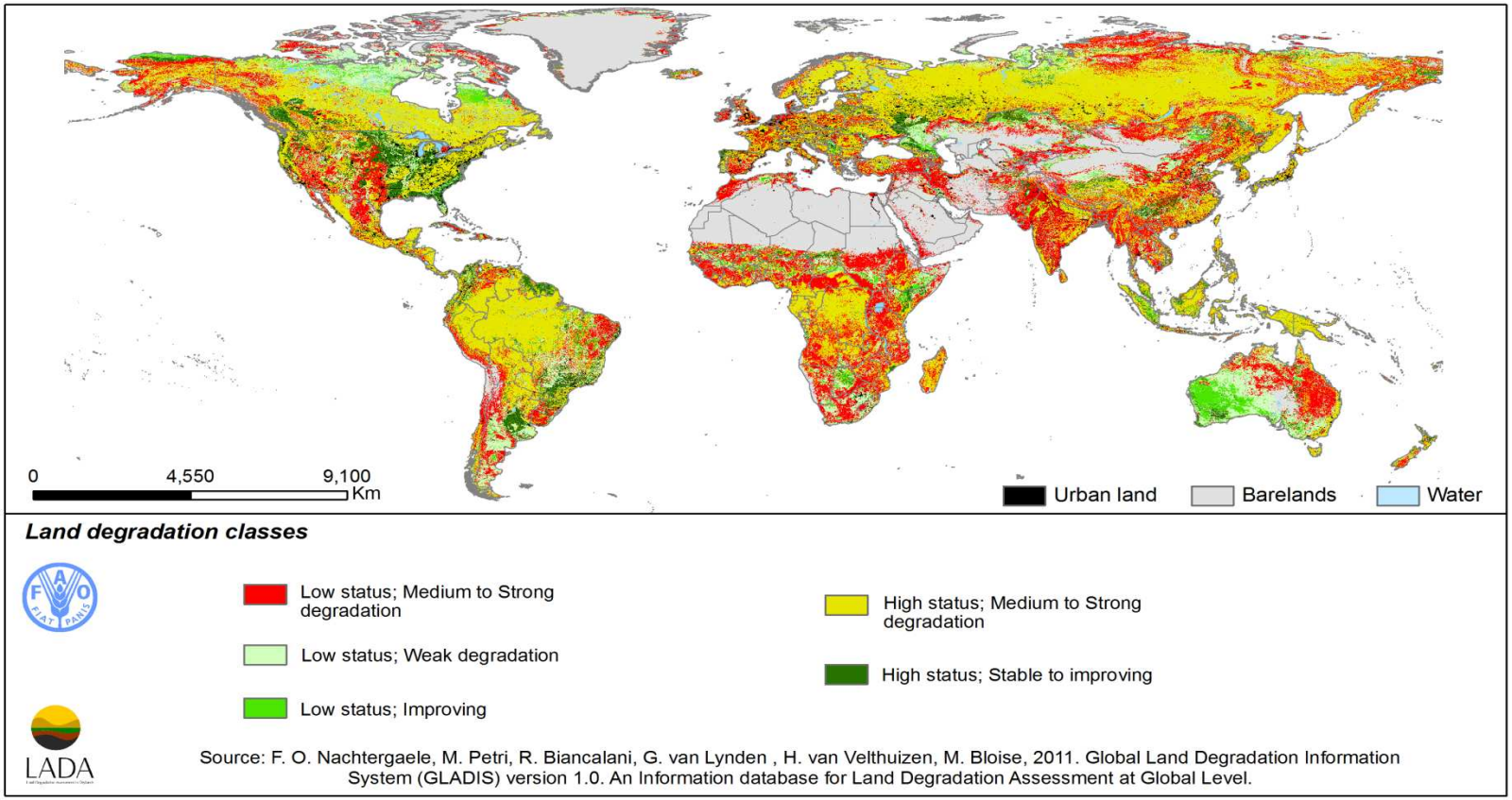


What are the problems with Soils?

- Over the past half-century, since the advent of the Green Revolution, world annual production of cereals coarse grains, roots and tubers, pulses and oil crops has grown from 1.8 million tonnes to 4.6 billion tones. It is now recognized that those enormous gains in agricultural production and productivity were often accompanied by negative effects on agriculture's natural resource base, so serious that they jeopardize its productive potential in the future. Negative externalities of intensification include land degradation, salinization of irrigated areas, over-extraction of groundwater, the builtup of pest resistance and the erosion of biodiversity.
- The declining quality of land and water resources available for crop production has major implications for the future (SOLAW, 2011).
- Soil is fundamental to crop production. Without soil, no food could be produced on a large scale, nor would livestock be fed. Because it is finite and fragile, soil is a precious resources that requires special care from its users. Many of today's soil and crop management systems are unsustainable. At one extreme overuse of fertilizer has led, in the EU, to Nitrogen (N) deposition that threatens the sustainability of an estimated 70% of nature (Hettelingh, J.P. et al, 2008). At the other extreme, in most parts of sub-Saharan Africa, the under-use of fertilizer means that soil nutrients exported with crops are note being replenished, leading to soil degradation and declining yields.

What are the problems with Soils?

- **Soils are fragile and under a high and increasing degradation:**



- **Water and wind erosion**
- **Nutrient depletion (OM)**
- **Salinisation**
- **Contamination**
- **Acidification**
- **Compaction**

Soil Health Management and Monitoring

- Soil health has been defined as: “the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, from beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive repercussions for soil water and nutrient holding capacity, and ultimately improve crop production”(FAO, 2008). To that definition, an ecosystem perspective can be added: a healthy soil does not pollute the environment; rather, it contributes to mitigating climate change by maintaining or increasing its carbon content (Save and Grow, FAO2011).

Soil Health Management and Monitoring

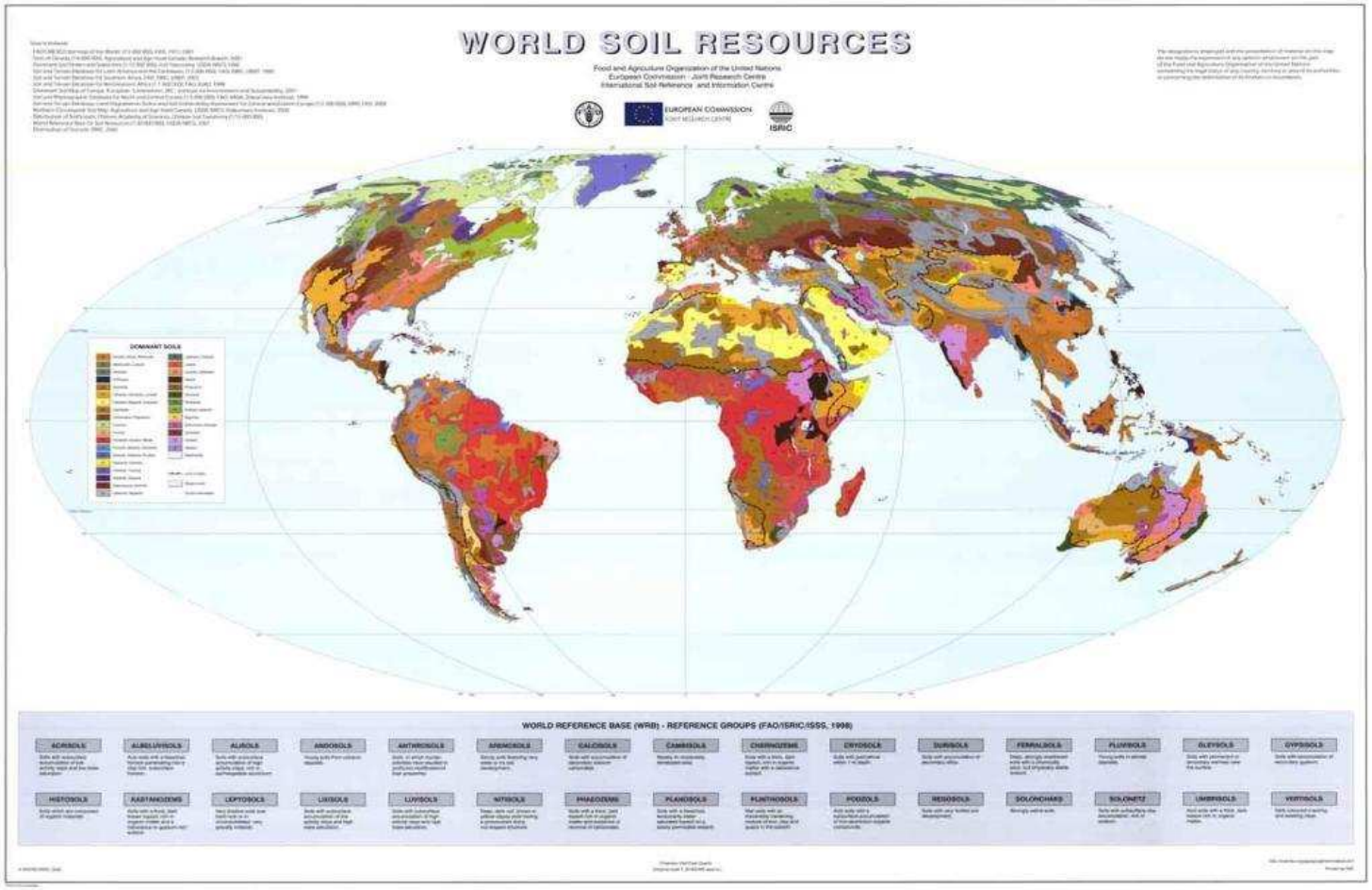
- Soil contains one of the Earth's most diverse assemblages of living organisms, intimately linked via a complex food web. It can be either sick or healthy, depending on how it is managed. Two crucial characteristics of a healthy soil are the rich diversity of its biota and the high content of non-living soil organic matter. If the organic matter is increased or maintained at a satisfactory level for productive crop growth, it can be reasonably assumed that a soil is healthy. Healthy soil is resilient to outbreaks of soil-borne pests.
- Functional interactions of soil biota with organic and inorganic components, air and water determine a soil's potential to store and release nutrients and water to plants, and to promote and sustain plant growth. Large reserves of stored nutrients are, in themselves, no guarantee of high soil fertility or high crop production. As plants take up most of their nutrients in a water soluble form, nutrient transformation and cycling – through processes that may be biological, chemical or physical in nature – are essential. The nutrients need to be transported to plant roots through free-flowing water. Soil structure is, therefore, another key component of a healthy soil because it determines a soil's water-holding capacity and rooting depth (Save and Grow, FAO2011).

Way Forward: soil health monitoring

Monitor soil health: policymakers and national institutions responsible for the environment are demanding methods and tools to verify the **impact of farming practices**. While **monitoring soil health is a very challenging task**, efforts are under way to implement it at global, regional and national scales. **Core land quality indicators** requiring immediate and longer term development should be distinguished. **Priority indicators are soil organic matter content, nutrient balance, yield gap, land use intensity and diversity, and land cover**. Indicators that still need to be developed are **soil quality, land degradation and agrobiodiversity** (Save and Grow, FAO2011).

Accounting soil resources?

- Different soil types with unique properties that could change in time as per the Land Use activity and intensity.



Accounting soil resources?

- There is no worst and best soil in general, it depends on what it is used for.
- A good soil for agriculture could not be necessarily good for urban constructions, or for forest.
- A good soil for growing cereals, could not be necessarily good for growing fruit trees.
- Even a poor nutrient soils could still be good for ecosystem services (regulation of flooding or could has a very important cultural value).




Accounting soil resources?

- Considering the current trends in population growth and food demands, agricultural soils (lands) are under pressure and threat.
- Commonly, urbanisation is affecting the most valuable agricultural soils.
- Ecosystem services are of key importance for future population growth and are under risk due to climate change.
- Potential for soil carbon sequestration increases the pressure or opportunities for sustainable land management.
- Degraded soils have no high value for provision services (production of goods), however they could still be valuable for other uses.

Questions and Challenges?

- Should soils be valued according to their properties? High soil carbon content; neutral pH, etc? Time dimension (soil properties change on time) as per land use intensity is the main driver.
- If accounting soils per soil type, there is a risk to over or underestimate the value of soils. Again, soils are useful for a number of functions.
- Will soil suitability (potentiality) should be pioneering an accountability process?
- How this accountability process could be implemented? Monitoring soil quality (standard values of soil properties?
- Costs involve for accountability?
- Is the accountability a window for pursuing sustainable soil management?