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Edited by
Ranoe S.Mangal-Jhari, Lydia Ori, Abdullah Adil Ansari, and
Wilfredo Colón

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CFCS Treasurer
Agricultural Experiment Station
Jardín Botánico Sur
1193 Calle Guayacán
San Juan, Puerto Rico 00936-1118

CFCS Website: http://cfcs.eea.uprm.edu/

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THE CONTRIBUTION OF SOIL MANAGEMENT TO FOOD SECURITY

Gerard den Ouden, Consultant, Belgium.

Introduction

The soil formation processes comprise of geology, environmental and soil processes (see figure 1).

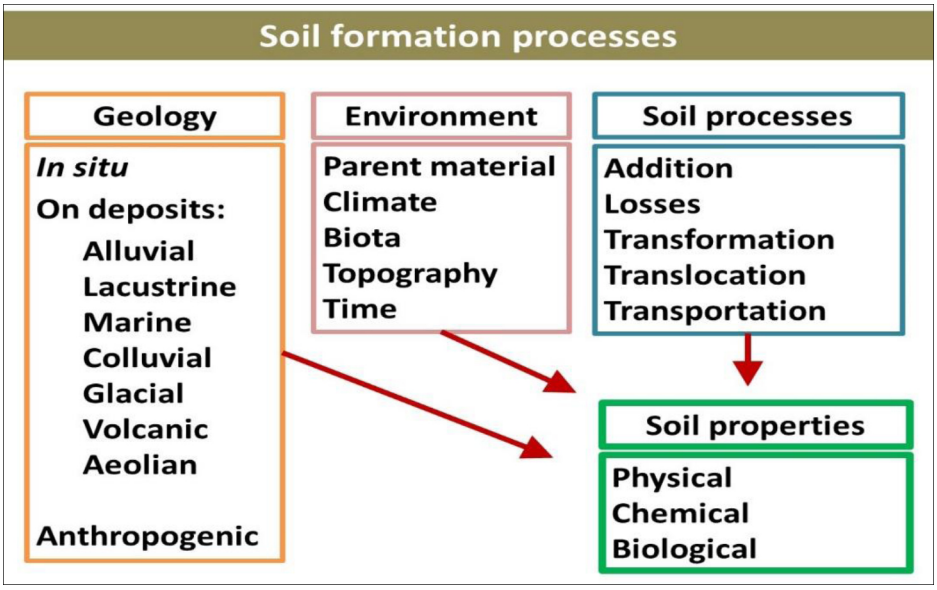

Figure 1: The soil formation processes

The main characteristics in the Caribbean are:

- Mean annual air temperature :15 – 30 °C
- Mean annual soil temperature (MAST) :15 - 22°C
- Rainfall :500 – 3,000 mm
- Soil moisture regime: =
    - Udic: semi-arid climate. Rain occurs during the growing season. Usually dry in summer.
    - Ustic: wet climate. Soils tend to be wet and irrigation of crops is not usually necessary.
- Varied soil types
- Varied land cover
- Main ecological zones: coastal regions, river valleys, humid regions, hilly slopes and marine and fresh water ecosystems.

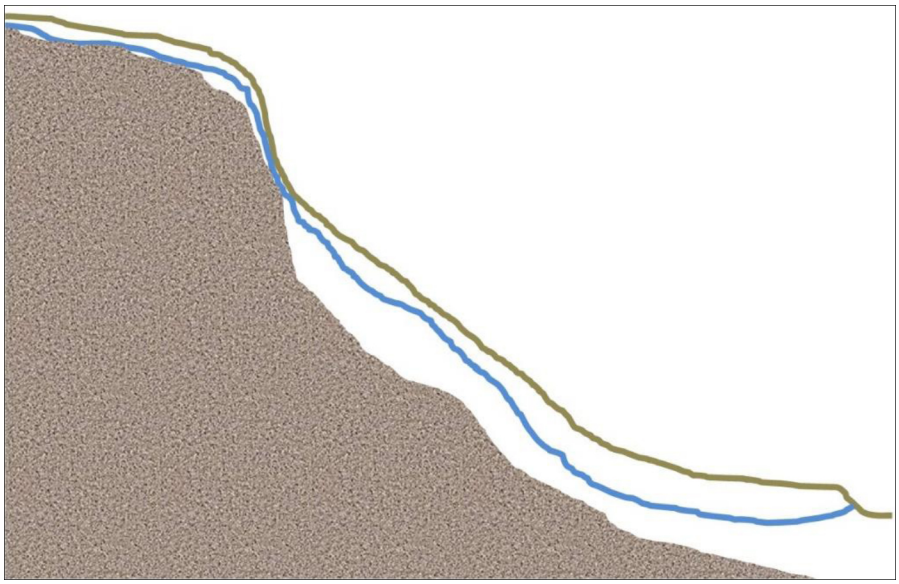

Figure 2: Landsurface catena

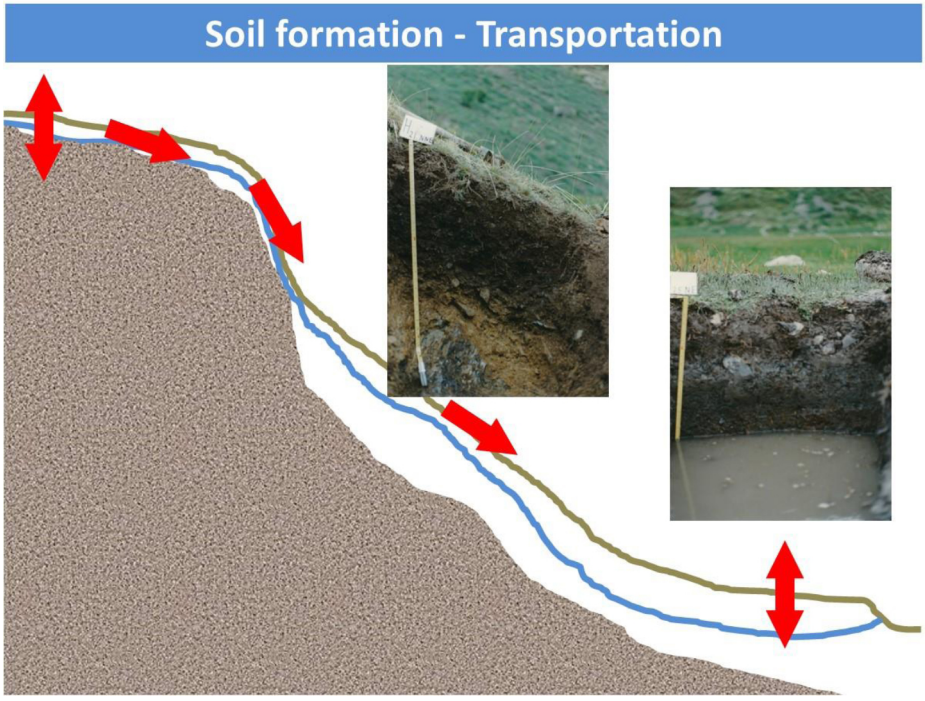

Figure 3: Soil formation

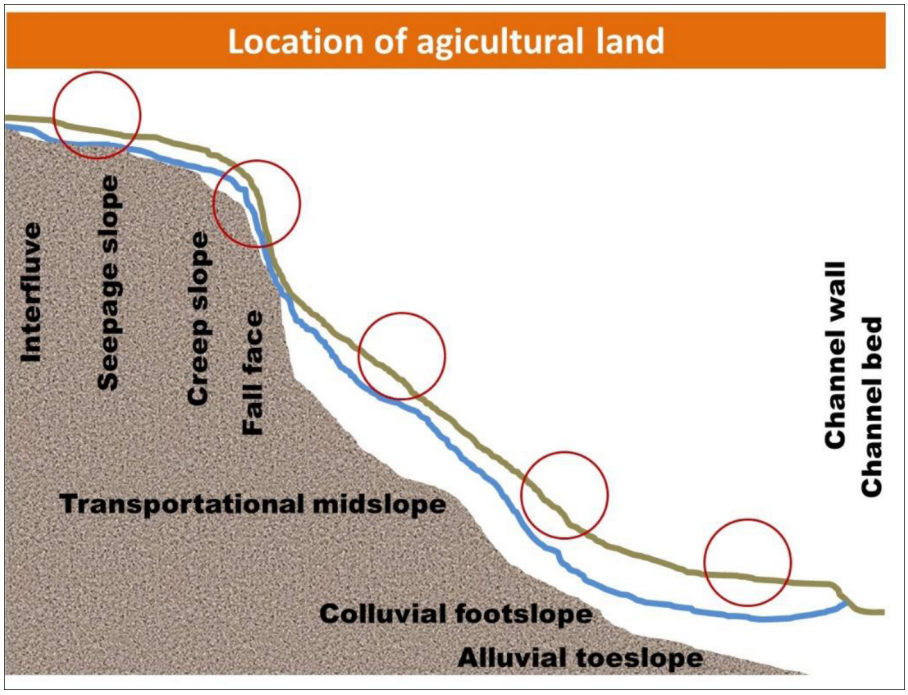

Figure 4: Location of agicultural land
Soil quality = soil health

The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and human beings. And with respect to food security, to support both the agricultural production and the provision of other ecosystem services. Figure 5 gives an overview of food los or wated per region and continent.

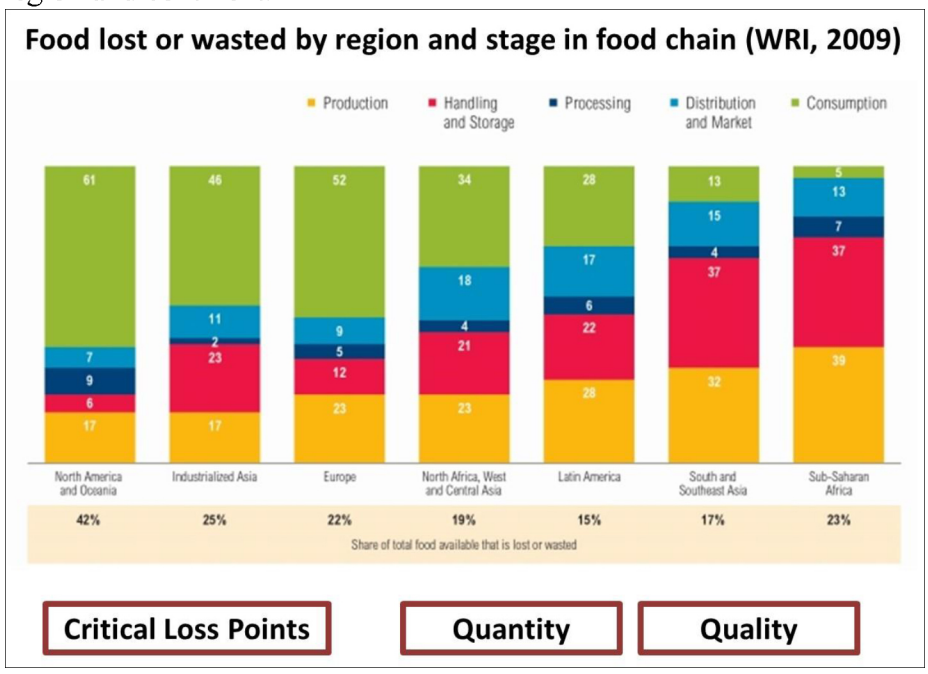

Figure 6: Comparison of food lost or waste per continent (WRI, 2009).

Soil services: Healthy soil give us clean air water, crops forests, grazing lands and landscapes.
Soil functions in various way such as:

- Regulating water: Control of water and dissolved solutes flow over the land or into and through the soil.
- Sustaining plant and animal life.
- Filtering and buffering potential pollutants - Soil minerals and microbes filter, buffer, degrade, immobilise, and detoxify (in)organic materials.
- Cycling nutrients: C, N, P + many other nutrients are stored, transformed, and cycled in the soil.
- Physical stability and support: Plant roots; Human structures; Protection for archeological treasures.

Soil is an ecosystem or environmental service: **"Soil as a natural resource is essential for meeting the food, fodder, vegetable fibre, fuel and water requirements of a rapidly growing human population"**

The negative externalities of or in soil are:

- from industries, households and traffic to agriculture
- from agricultural land to the environment (remnants of fertilisers and pesticides, ash and smoke from burning practices)**.**

What are the problems which soil has to deal with?

- Soil pollution (Impact on public health, animal health, one health, canopy cover, soil fauna)
- Physical erosion (natural - rain, wind, flooding, earthquake; human induced – exploitation)
- Biological and Chemical erosion (overexploitation, depletion of nutrients)
- Negligence and ignorance in soil + water management (sewage, trash, dumping of waste, erosion)
- Exploitation (surface and subsurface mining)
- Soil-borne diseases
- Land use changes (peri-urban agriculture, deforestation), overexploitation of natural resources, climate change and social inequalities, but also mismanagement are the main causes of land degradation
- Political diversity (non-continuous policies).

(Some examples: goldmining in Suriname, waste landfill, flooding in Guyana in 2005, deforestation in Haiti).

The challenges for us are:

- To reduce soil degradation
- Look at the impact of Climate change: "Climate-smart agriculture practices can and are reducing emissions in food production systems as well as increase farmers' resilience to climatic changes and protect food security."
- Population growth
- Economic growth

- Agricultural dynamics: "Changes in crop growing systems by using climate-adapted species which are still of interest to the market are needed to ensure both soil health and rural economy."

How to sustain the extending ecosystem services of soil?

There are several ways to sustain the ecosystem services:

- Zero-tillage or low-tillage agriculture (minimum soil disturbance, therefore preserving carbon stocks)
- Intercropping with nitrogen-fixing plants; Agroforestry
- Planting more cover crops, like shelter crops or other vegetation, increases biomass that nourishes the soil.
- Crop rotation and fallow
- Mulching
- Low input agriculture (pesticidal plants, mechanization reduction)
- Incorporation of biowaste, other organic soil additives
- Biochar ('Terra Preta')
- Avoid slash-and-burn
- Water harvesting and groundwater recharge
- Soil conservation (terracing, …)

This need a cooperation between several stakeholders (farmers, reserachers, policy makers, ectension workers) for achieving healthy soil (see figures 7 and 8).

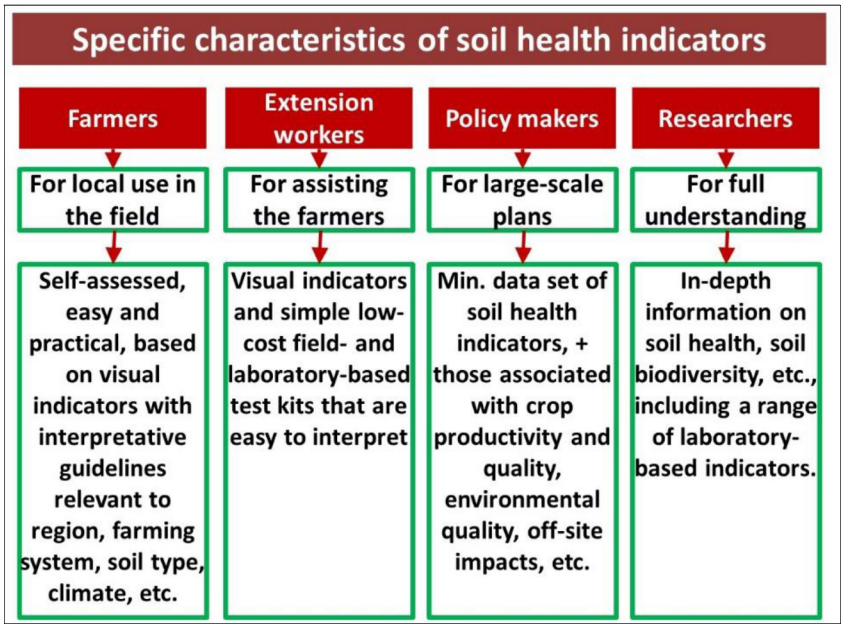

Figure 7: Indicators of a healthy soil.

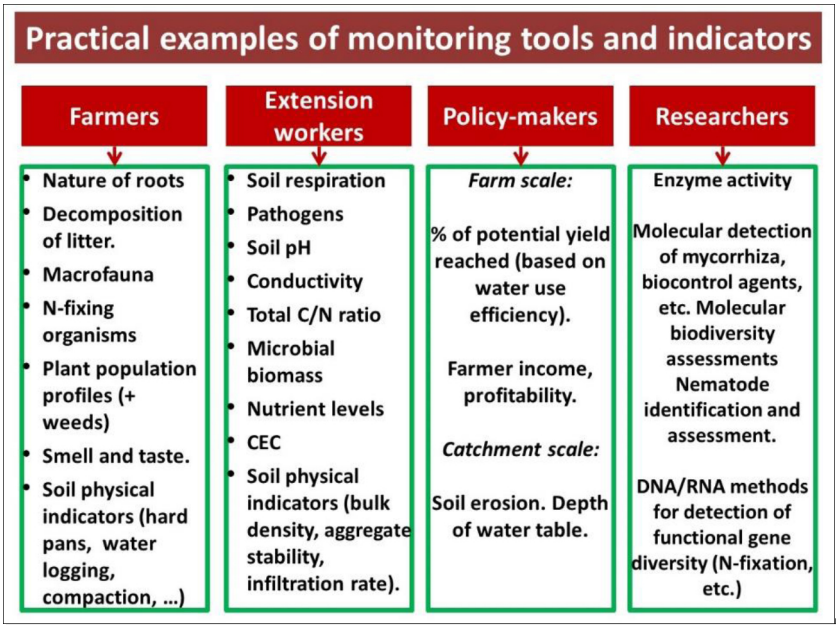

Figure 8: Collaborators and monitoring tools for a healthy soil.

We should take a holistic approach in the following aspects:

- Conduct research on the variability of soils and its potentials, to make models (e.g. FAO AquaCrop Model; biophysical).
- Conduct a mapping on Caribbean-specific soil characteristics, incl. land characteristics (Land Utilization Types, agro-ecological zones), soil parameters per LUT (morphology, fertility, vegetation communities, indicator species, drainage index, soil biodiversity index with a relation to target and threshold levels) and general environmental parameters (rainfall and weather parameters,…).
- Ethnopedology.
- Land property: soil audits and soil passports with a focus on use (industrial, residential, agricultural, forested land, etc., incl. past uses – large/small holding farms, secondary forest, etc.), quality (fertility, depth, drainage; tillage, soil biodiversity), environment (surrounding land use types), and hydrology (GWT, water quality and access to water sources). - GIS / GPS, land registry.
- Green marketing ('Controlled designation of origin').
- Prepare a monitoring scheme of land and soil quality (historical data, baseline data, follow-up data, interpretation to climatic + human impacts and natural hazards).
- Condust best practices in soil and water management at local scale with stakeholder events.
- Soil legislation (e.g. Soil protection laws).
- Environmental planning (soil demand, protected areas) in combination with Environmental Impact Assessments (EIA).
- Risk aversion / climate mitigation plans to ensure soil capacities:
- Fluctuation in weather patterns (less rainfall, intensified rainfall)
- Flooding risks (SIDS)
- Occurrence of natural hazards
- Increase in solar radiation (affecting plant growth)
- Increase in land pressure (population growth, economic exploitation of land)

- Pollution monitoring – alarm system; Weather forecast sytems – Internet / GSM
- Regional Caribbean Soil and Water Knowledge Centre accessible to the public at large (with links to universities, research centres, stakeholder fora, NGOs at regional and global level) to collect, study and exchange information, to promote best practices, and to provide advice. Local (or national) hubs should be introduced to liaise with local groups/persons.
- Commitment required from national / regional authorities.
- Outspoken and demonstrated initiatives towards preservation / restoration / improvement of the soil resources: Farmer Field Schools; showcasing good practices; frequent visits of extension services together with academia, NGOs, etc.; public awareness campaigns (TV, radio…); demonstration sites
- Integrated watershed management.
- Innovative natural soil additives.
- Continued dialogue between producers, traders, planners, financers, educators and consumers.
- Continued research in sustainable climate and environment-adapted agricultural systems (feasible and market-oriented).

Good soil is our health!