

1.1 Description of climate and soil

Climatic conditions

The humid tropics are located between 10° N and 10° S along the equator. The tropical rain forest is the main eco-zone of this climatic belt and can be found in Amazon, Congo basin and Indonesia. The annual average temperature varies from 20 to 27 °C on sea level. Because of the vertical radiation, sunshine is actually very intense. But the sky is cloudy during several hours per day by heavy rain clouds. The difference between night- and day temperatures is rather small. In mountainous regions temperatures reduce 0.6 °C per 100 m altitude.

The average relative humidity of 80 % and the intense solar radiation create a hot and humid climate. The average annual rainfall ranges between 1500 and 2500 mm, in some regions it can even reach 7000 mm. Next to the equator precipitation usually occurs daily in strong rainfalls, regularly up to 100 mm per hour. Violent rainstorms are also frequent.

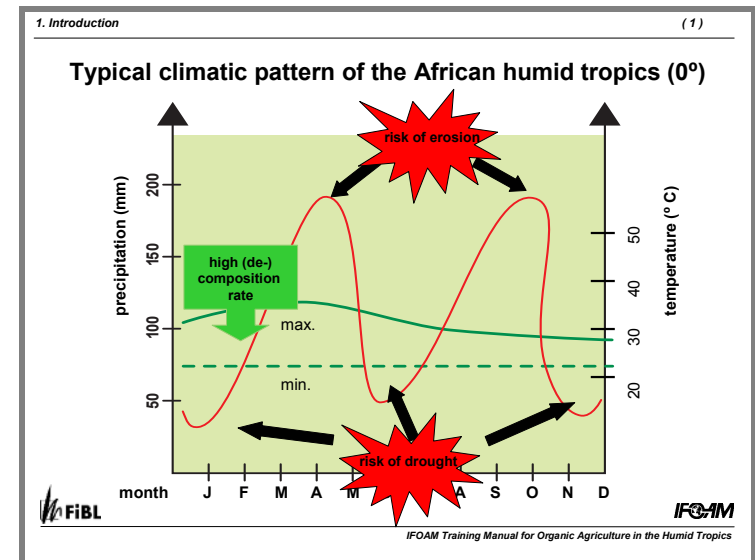
In Africa, next to the equator, there are two rainy seasons from 4 to 5 months. In the outer tropical regions one long rainy season of 8 to 9 month during the summer exists. But even during so-called rainy seasons, there are sometimes periods of two or more weeks without rain. In Asia or South America the division of the rainfall is slightly or very different. Additionally, local climate is in many places influenced by other climatic disturbances. One typical example is the tropical rainstorm "El Niño" in the Pacific. Therefore exact climate descriptions are only valuable for well defined micro-climates.

Lessons to be learnt:

- Humid tropical climates enhance vigorous plant growth and high (de-)composition rates.
- Violent rainfalls have a strong impact on agricultural issues, especially on soil erosion. Water management is therefore crucial.
- Protect and replenish organic matter content of agricultural soils.
- Natural ecosystems act as a model for agricultural practices: Close the nutrient cycles.
- Healthy plants are less prone to various pests and diseases.

Group work:

Divide the group and let them draw a climate pattern of their region. Ask them to explain the climatic challenges for agriculture under their conditions in individual presentations.



Transparency 1. (1): Typical climatic pattern of the African humid tropics at the equator.

Soils of the humid tropics

There is a wide range of soil types in the humid tropics. They depend on geology, geomorphology, vegetation and rainfall pattern. There are very productive, but also very weak soils.

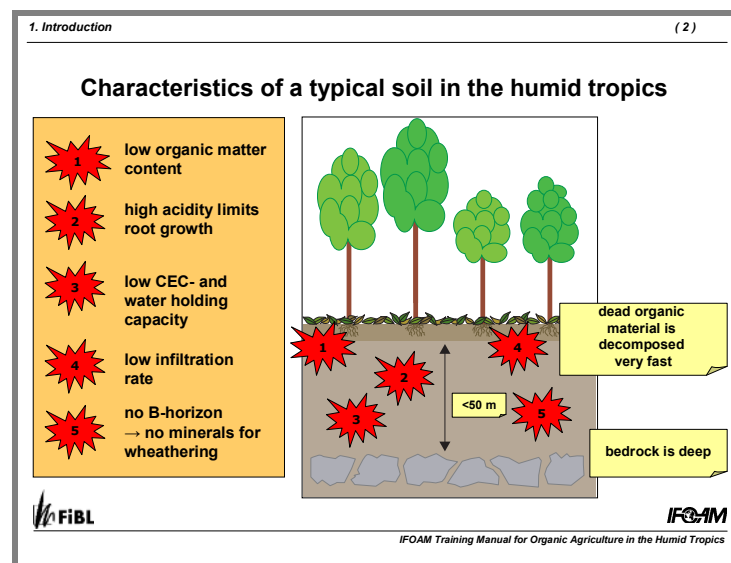
The most dominant soils in many humid tropical regions are weathered ferralitic soils. Oxisols together with Ultisols occupy over 30 % of the Tropics. These soils have in common, that they are quite infertile, are low in organic matter and have a low water holding capacity. Large amounts of rainfalls are therefore lost as run-off water. This is especially valid for hilly areas and is the main cause for erosion and landslides. Many of these soils are very old and reach 20 to 50 m of depth. Unfortunately, plants cannot root deeply because of high aluminium toxicity.

- Oxisols are abundant, especially in the Amazon and in the Cerrado in South America and in Central Africa. As an additional negative characteristic they make phosphorus unavailable for plants.
- Ultisols are dominant in tropical America, Africa and in the uplands of South-East Asia. They are in the last stage of weathering, what makes them extremely poor in available minerals. Further limiting characteristics are their acidity (pH 6 or less), a weak nitrogen content and low cation exchange capacity (CEC).

Beside these marginal soils clay or loam soils, so as Alfisols, offer better conditions for agriculture. Alfisols cover approximately 20 % of the tropics and are good agricultural soils. They mainly exist in Africa, in Asia and tropical America.

Probably the most fertile tropical soils are Andisols, which are young and rich in minerals but exist in volcanoes regions only. They possess satisfying amounts of organic matter and are very productive.

For further information about soil structure, soil organisms and soil testing consult chapter 3 "Soil fertility" of the Basis Manual.



Transparency 1. (2): Characteristics of a tropical soil in the humid tropics

Discussion on soils:

- Which typical problems can appear by cultivating these soils?
- Which are possible advantages or chances of these soils?

1.2 Influence of climate and soil conditions

Humid tropical conditions such as hot temperatures, high annual rainfalls and poor soil properties require well adapted agricultural practices. The tropical rain forest as original ecosystem with its closed nutrient cycles and biodiversity serves as an ideal role model concerning nutrient management and cropping patterns. Tropical farming can only be sustainable, if the main rules of this original system are respected.

Water management

Water conservation technologies play an essential role in water management, due to violence of tropical rainfalls and soils having low infiltration rate. As a result, soils cannot hold large amounts of water. This causes in drought stress hindering crop growth between the rainy seasons, although yearly rainfall amount is actually abundant.

In addition to this, water management plays also an important role in erosion protection. For further information see next chapter.

Soil protection and management

Technologies like slash-and-burn cultivation or mechanical forest clearing, that are common in tropical regions, leave uncovered land surface, which is prone to erosion. In hilly areas bare lands are additionally vulnerable to landslides. These factors lead to irreparable soil losses which increase the pressure on arable land. Non-climatic factors like physical degradation from compactation and soil crusting, due to excessive use of machinery and soil pulverisation aggravate the situation.

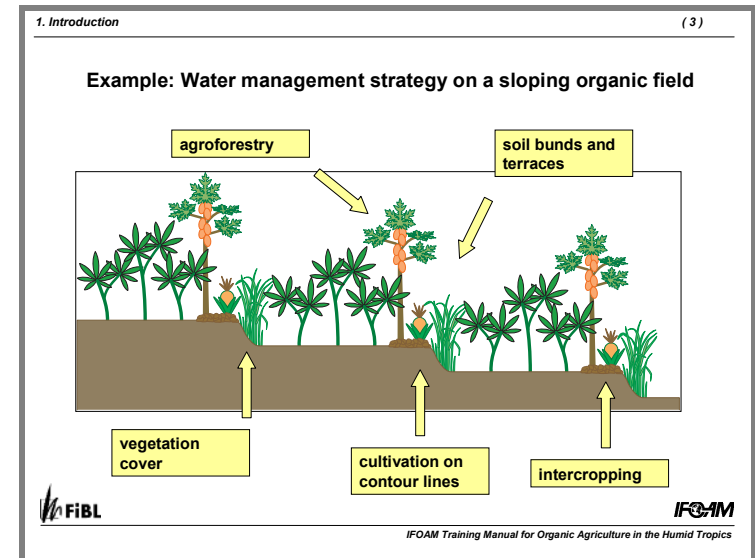
Arable land can be protected from erosion by soil bunds and terraces, minimum tillage and contour cultivation. Planting cover crops, mulching, intercropping and agroforestry plays also an important role in the protection against erosion and landslides, because their rooting system fixes the soil. Further, these technologies increase the organic matter content of the soil, which has also positive effects on water holding capacity. Additionally, the vegetation cover conserves humidity by protecting the soil from direct sun radiation.

For additional information about soil erosion and practical tips for protecting constructions read chapter 3.4. "Soil Erosion" of the Basis Manual.

Experience sharing:

Even in regions with high annual rainfall, drought periods can decrease crop yield. For this reason water conservation systems are fundamental:

- *What effective water collecting systems exist in the participants' regions?*
- *Which kinds of reservoirs, wells, cisterns etc. are known?*
- *How are they managed?*



Transparency 1. (3): Example: Water management strategy on a sloping field.

Group work:

Divide the participants into three groups. Let each group discuss on soil protection strategies against erosion with examples used in their areas and let them give reasons for their choice. Let each group present in plenary.

Soil fertility

The fertility of tropical soils is highly influenced by their organic matter content. In the natural eco-system of the rainforest, plant growth is vigorous and biomass is decomposed by soil organisms rapidly into humus and organic matter. Due to hot temperatures and high air humidity organic matter is mineralized very fast. In order to keep the balance in the soil, dead plant material is required as a back-up for rebuilding humus and organic matter.

On cleared agricultural land this back-up is often insufficient. Once vegetation cover is removed, the remaining humus gets mineralized. The released nutrients are leached, because of heavy rainfalls washing out the uncovered soil.

In order to keep the essential humus content, tropical agricultural soils should therefore always be covered with dead or living vegetation. This covering biomass does not only deliver organic material, it also protects the soil structure. Organic matter plays also an important role in water holding capacity, neutralizing acidity and workability of tropical soils.

Beside organic matter content, cropping pattern plays an important role in maintaining soil fertility. Especially in soils of the humid tropics, where nutrients are often limited, monocultures should be avoided, because they leach the nutrient pool of the soil in an unbalanced way.

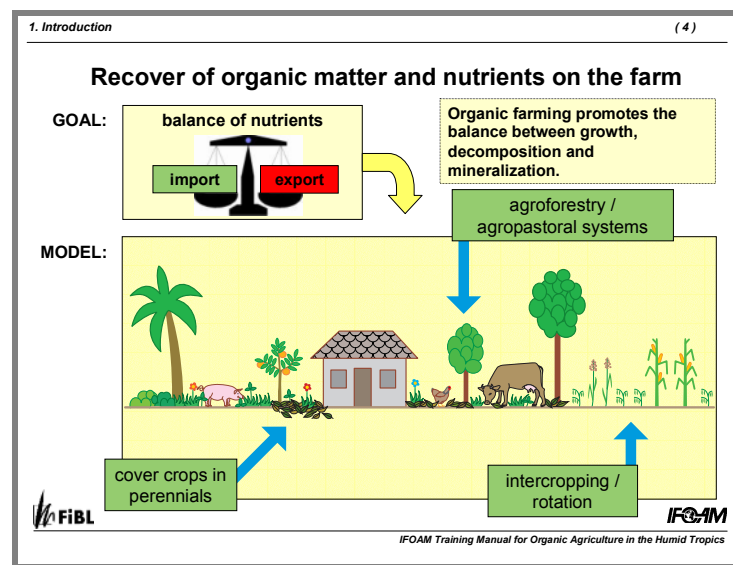
See also chapter 3 “Soil fertility” of the Basis Manual.

Organic fertilization

Even in sustainable agricultural systems, nutrient cycles are not closed on the field, as the yield is taken away. Marginal soils of the humid tropics are especially prone to nutrient and organic matter loss. Therefore, healthy soil life as the base for successful production can only be achieved, if nutrients are imported. Fortunately, not only decomposition processes, but also composition processes are moving fast in the humid tropics. Animal or green manure and compost favors this balance and can replenish nutrients required by crops and supply the soil with essential organic matter. Legume plants are additionally a highly valuable source for nitrogen.

Note: Organic farming in this climate has to promote the balance between growth, decomposition and mineralization.

For additional information about plant nutrition read chapter 4. “Plant Nutrition” of the Basis Manual.



Transparency 1. (4): Recover of organic matter and nutrients on the farm

Group work:

Discuss how nutrients, which have been exported with the harvested products, can be given back to the soil. Think about possible problems or constraints when using methods that are explained in the transparency. And find suitable solutions.

Pest and disease management

The climate in the humid tropics is favorable to plant growth. But it does not only apply to crops and weeds, but also to pests and diseases, and to natural antagonists, too. Being able to support plant growth throughout the year, the humid and hot conditions ensure an abundant supply of food to pests for almost the whole year. Pests can breed more frequently due to the constant warmth and pest booms are common, especially towards the end of the rainy season(s).

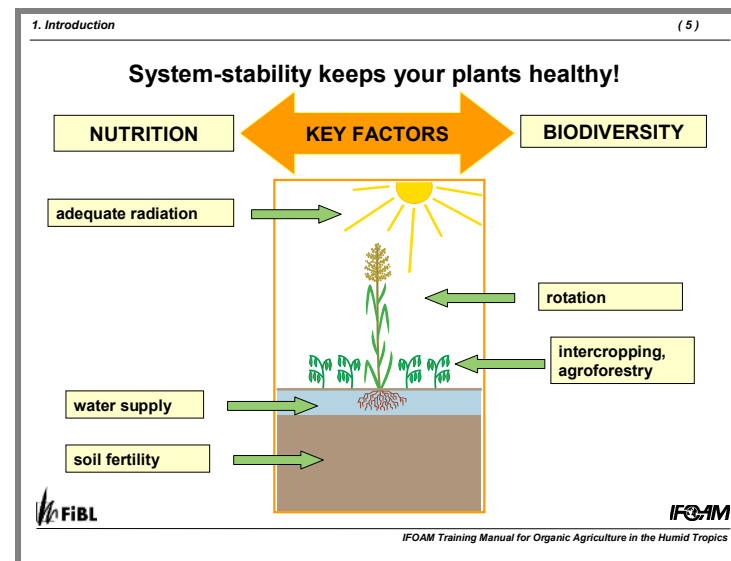
The high relative humidity also interacts with the warm temperatures leading to high incidences of humidity related diseases, especially fungal infections.

With this scenario, organic farmers in the humid tropics have to apply accurate pest and disease management strategy: Primarily, they maximize system stability through diversity, rotation and preventive measures. Only then, if necessary, they apply control and curative measures.

Preventive measures are:

- Use of healthy clean seeds and planting material.
- Promotion of natural enemies by leaving grass strips and controlled bush hedges which act as habitats for beneficial organisms.
- Appropriate spacing avoids competition between the crops, which would weaken the plants and ensures good ventilation to avoid fungal diseases.
- Keep the soil fertile with organic matter supply to offer the plant best growth conditions for being strong.
- Timely planting so that crops develop resistance before pests build up.
- Timely weed control to reduce competition and remove alternative sources of pests and diseases.
- Intercropping and crop rotation control pest and diseases.
- Good hygiene / sanitation to remove disease and pest reserves.

Curative measures have to be applied according crop and local possibilities.



Transparency 1. (5): System stability keeps your plants healthy!

Experience sharing:

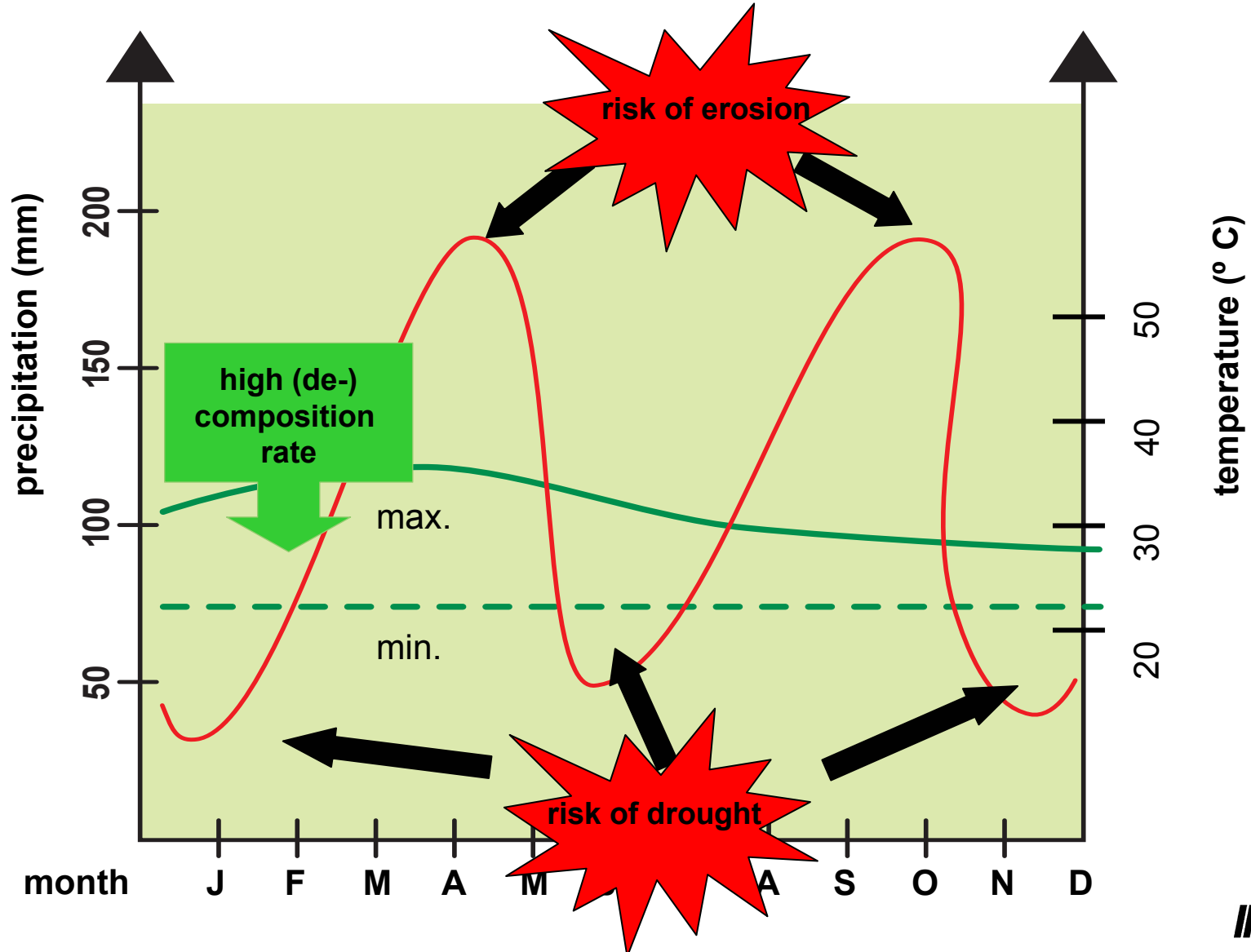
Let participants tell about their most effective measures in pest and disease management and fill it in the table (poster).

Area	Method	Timing	Impact
Soil			
Crop			
Environ-ment			

Recommended further reading:

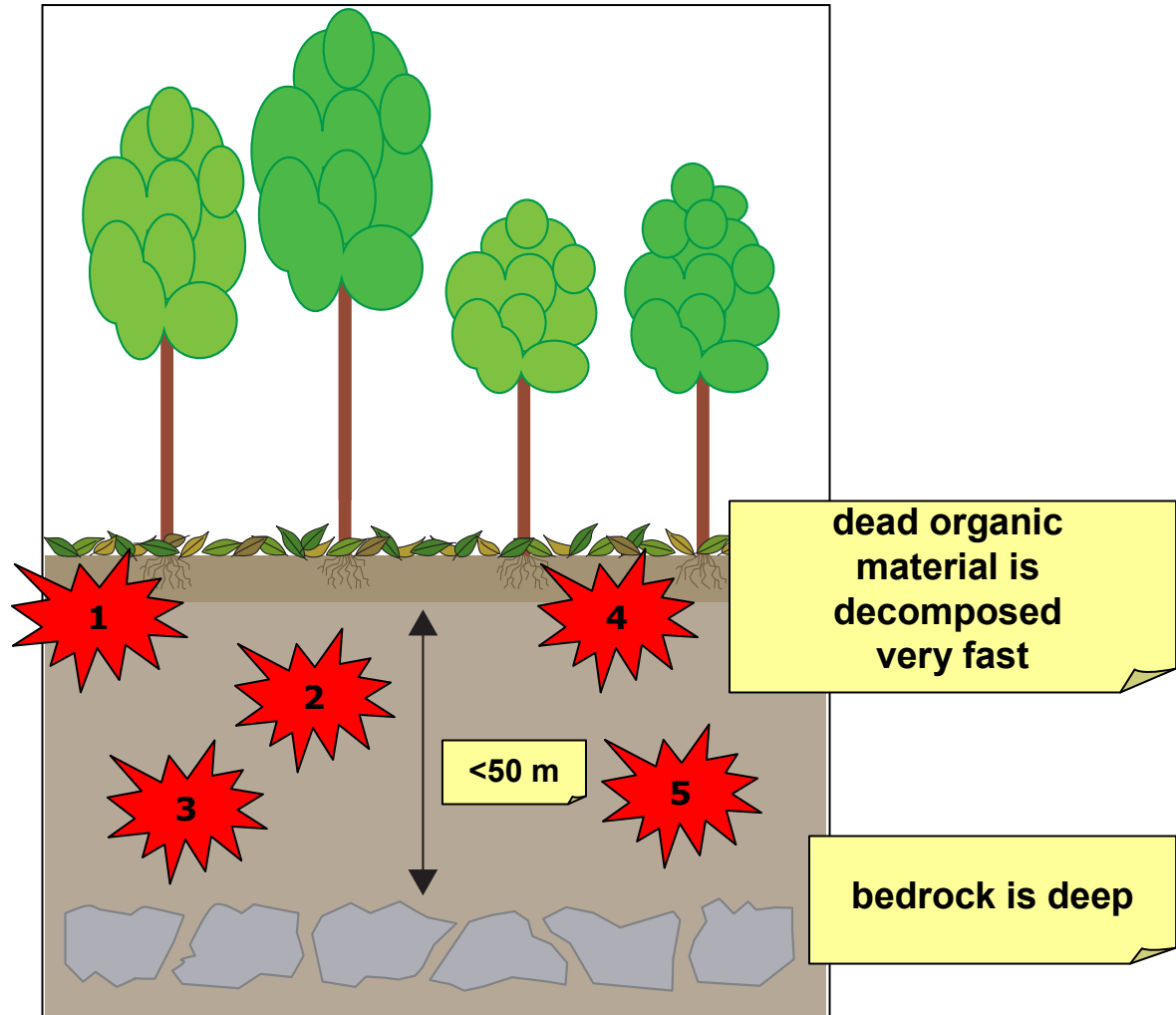
- *Proyecto MAG/FAO/GCP/COS/012/NET. 1996. Agricultura Conservacionista: un enfoque para producir y conservar. Ministerio de Agricultura y Ganadería y Organización de las Naciones Unidas para la Agricultura y la Alimentación. Informe Técnico 1.*
- *J. García. 1997. La agricultura orgánica en Costa Rica. Revista Acta Académica, Universidad Autónoma de Centro América. (20) 74-83.*
- *W. Forsythe. 2002. Parámetros ambientales que afectan la temperatura del suelo en Turrialba, Costa Rica y sus consecuencias para la producción de cultivos. Revista Agronomía Costarricense (26) 45-61.*
- *Wilhelm-Gunther Vahrson. 1991. Taller de erosión de suelos: resultados, comentarios y recomendaciones. Revista Agronomía Costarricense (15) 197-203.*
- *G. Meléndez, G. Soto y L. Uribe. 2003. Abonos orgánicos: principios, aplicaciones e impacto en la agricultura. En memoria de taller sobre abonos orgánicos. Universidad de Costa Rica.*
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- *V. Watson. 2003. Bioclimatología. En curso de certificadores de uso conforme del suelo. Colegio de Ingenieros Agrónomos y Ministerio de Agricultura y Ganadería.*
- *W.C. Beets. 1990. Raising and Sustaining Productivity of Smallholder Farming Systems in the Tropics. AgBé Publishing, Holland. 176 – 225.*
- *A. Young. 1997. Agroforestry for soil management. CAB International and ICRAF.*

Typical climatic pattern of the African humid tropics (0°)

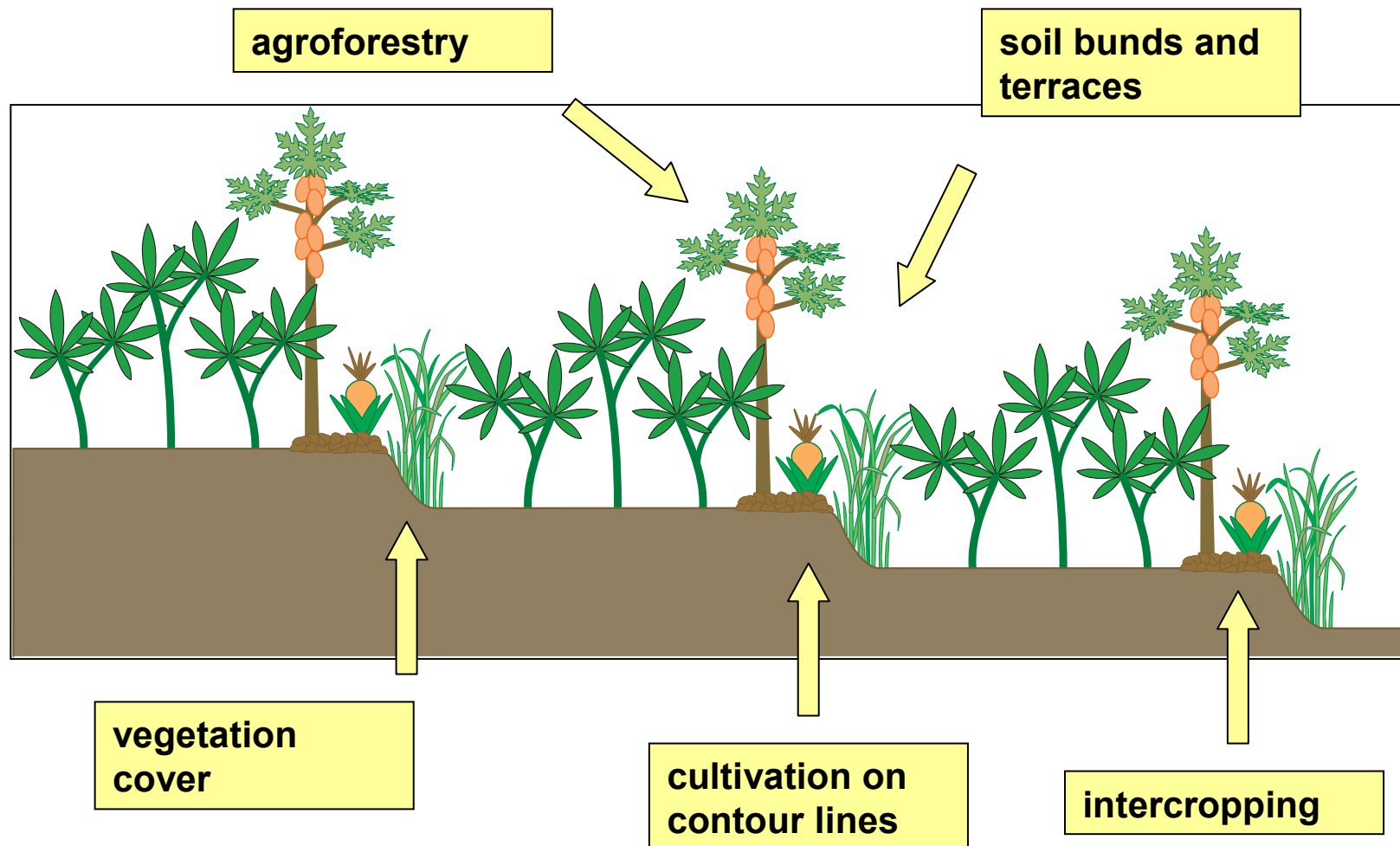


Characteristics of a typical soil in the humid tropics

- 1** low organic matter content
- 2** high acidity limits root growth
- 3** low CEC- and water holding capacity
- 4** low infiltration rate
- 5** no B-horizon → no minerals for weathering

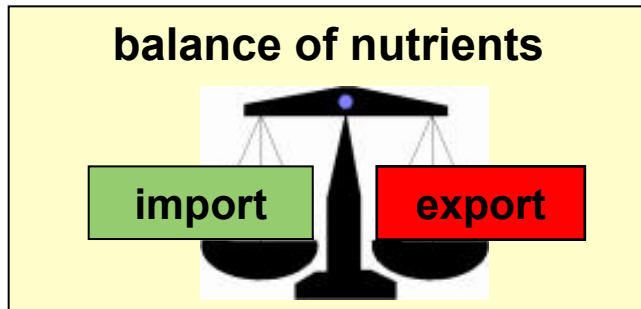


Example: Water management strategy on a sloping organic field



Recover of organic matter and nutrients on the farm

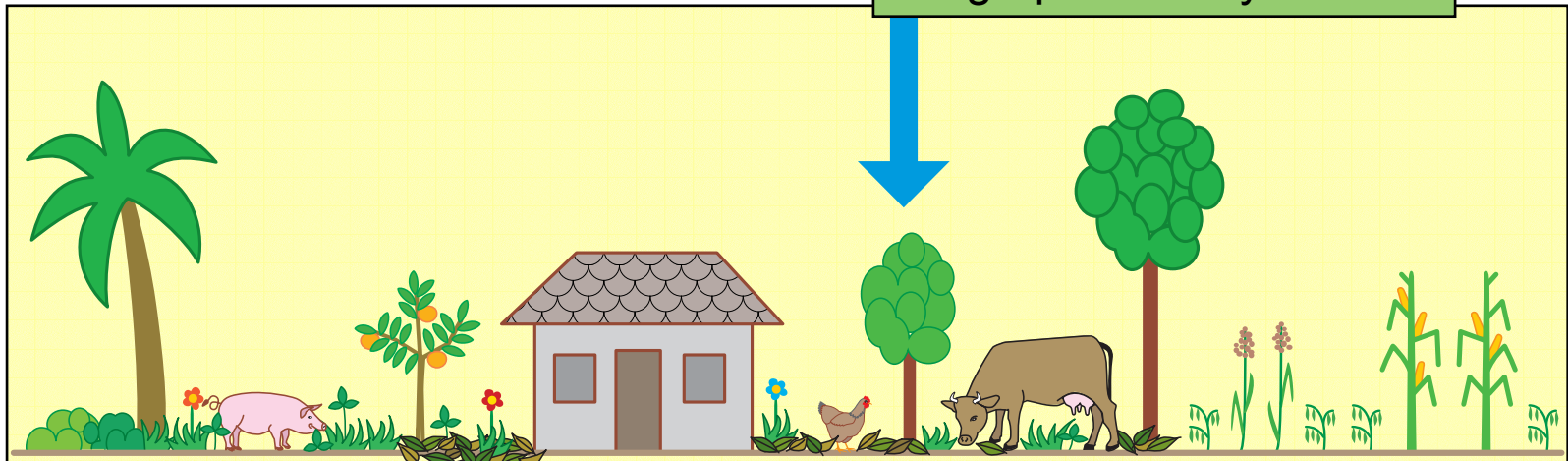
GOAL:



Organic farming promotes the balance between growth, decomposition and mineralization.

agroforestry /
agropastoral systems

MODEL:



cover crops in
perennials

intercropping /
rotation



System-stability keeps your plants healthy!

