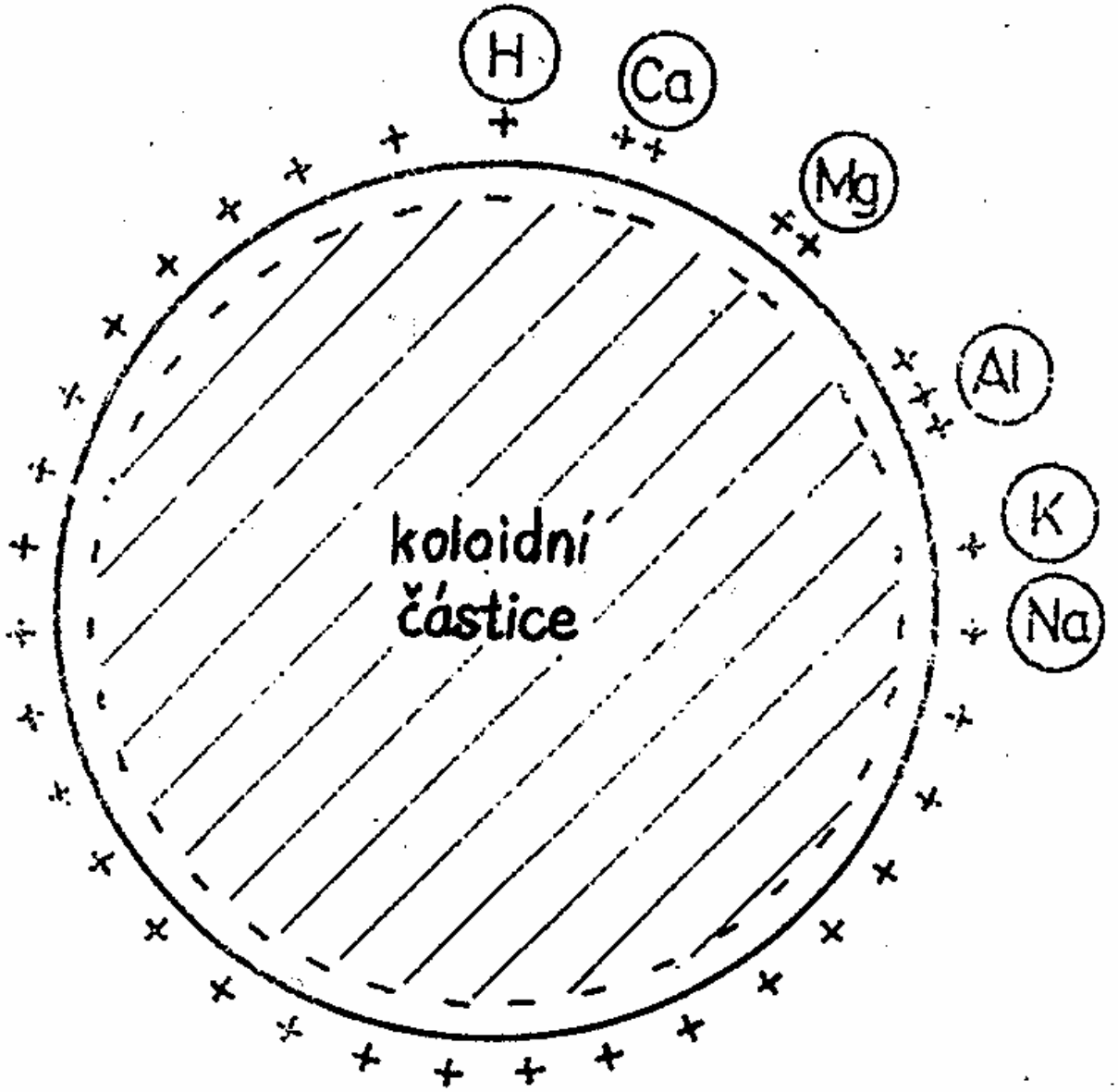
The saprotrofic food chain in terrestrial ecosystems : Soil

Soil colloid particle



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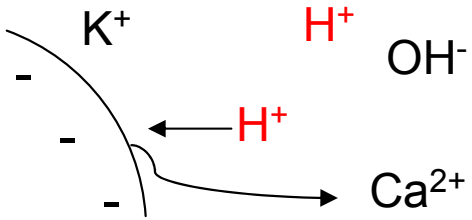
Soil Buffer Capacity / **Pufrovací kapacita půdy (půdní ústojčivost)**

Buffer Zone pufrovací zóna (systém)	Soil pH pH půdy	Chemical Reactions chemické reakce
Carbonate (Lime) karbonátová	6.2 – 8.6	$CaCO_3 + H_2CO_3 \longrightarrow Ca(HCO_3)_2$ $CaCO_3 + H_2SO_4 \longrightarrow Ca^{2+} + SO_4^{2-} + CO_2 + H_2O$
Silicate silikátová	5.0 – 6.2	$[(-SiO_4)Al]^- + 4\ H^+ + 6\ H_2O \longrightarrow (-SiOH)_4 + [Al(H_2O)_6]^{3+}$
Cation Exchange Capacity kationtové výměnné kapacity	4.2 – 5.0	
Aluminium hliníku	3.0 – 4.2	$[Al_6(OH)_{15}]^{3+} + 15\ H^+ + 21\ H_2O \longrightarrow 6\ [Al(H_2O)_6]^{3+}$
Iron železa	3.0 – 3.5	$FeOOH + 3\ H^+ + 4\ H_2O \longrightarrow [Fe(H_2O)_6]^{3+}$

The saprotrofic food chain in terrestrial ecosystems : Soil

Tropical ecosystems – tropical soils

Very high primary production, lush vegetation (rain forests)

Climate: - very high precipitation,
- high temperature

Original notion
(since Alexander von Humboldt):

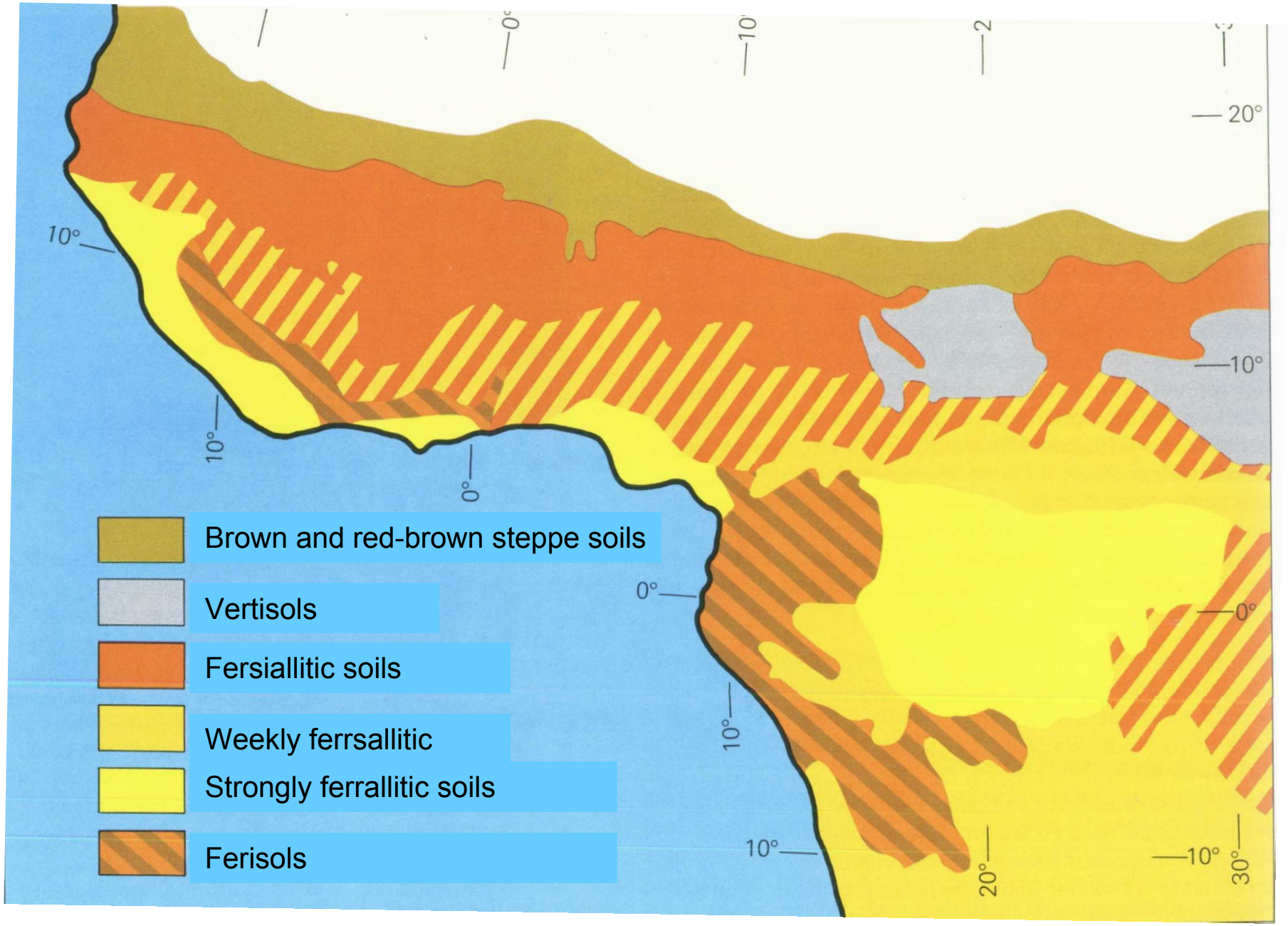
Optimal conditions for plant growth
– agricultural production?!

Why have efforts to turn rain forests into farmland been so little successful?

High precipitation levels – leaching of nutrients

The saprotrofic food chain in terrestrial ecosystems : Soil

Zonal soil types in West Africa



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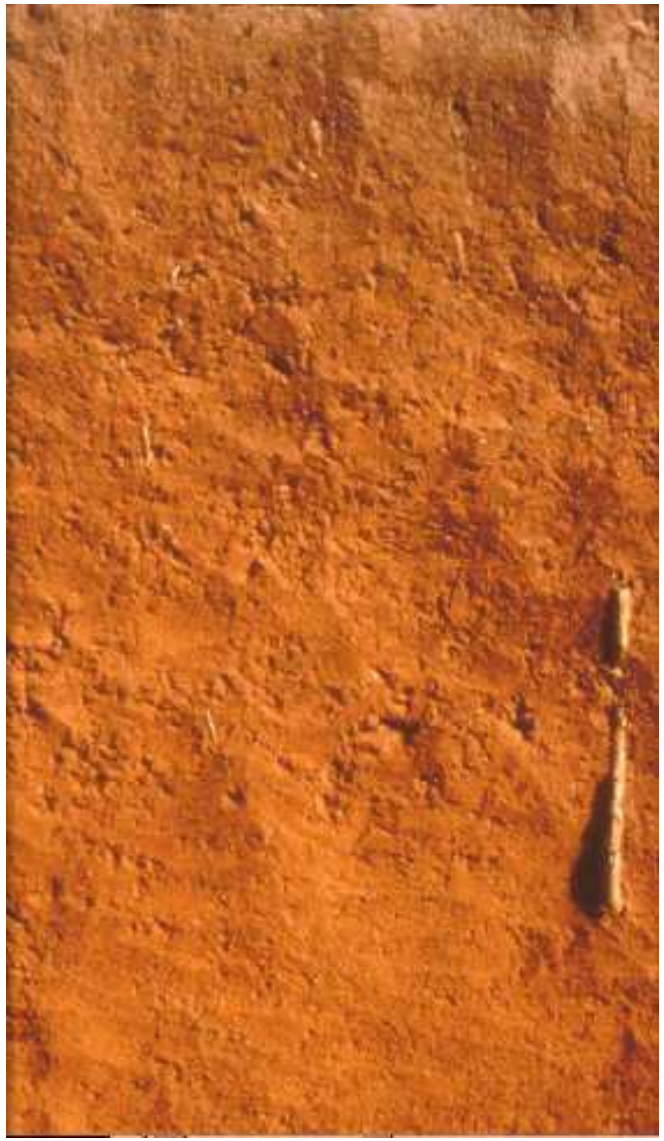
Tropical soil types



Ferralsol (Oxisol)

Vertisol)

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Clays:

-Microcrystals forming in the process of weathering of parent material (rock)
- crystals consist of sheet cristalls made of octaheders of aluminiumhydroxide and tetraheders of silicium oxide.

Different types of clay minerals differ amongst others their in crystal structure:

Three sheets: Si-O / Al-OH / Si-O } chlorites, illites, vermiculites, montmorillonites (outside the tropics)

Two sheets Al-OH / Si-O } kaolinites (in the tropics)

Montmorillonite

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Characteristic composition of the weathered layer above parent rock outside of and in the tropics

	Great Britain		Medditerranean		Westghats	
compound	rock %	Weathered material %	rock %	Weathered material %	rock %	Weathered material %
SiO_2	49,3	47,0	44,7	35,7	50,4	0,7
Al_2O_3	17,4	18,5	15,5	34,9	22,2	50,5
Fe_2O_3	2,7	14,6	7,5	7,9	9,9	23,4
FeO	8,3	–	3,7	0,7	3,6	–
MgO	4,7	5,2	7,9	3,6	1,5	–
CaO	8,7	1,5	15,3	4,9	8,4	–
Na_2O	4,0	0,3	1,1	0,9	0,9	–
K_2O	1,8	2,5	1,4	3,1	1,8	–
P_2O_5			1,7	2,8		
H_2O	2,9	7,2	0,9	5,8	0,9	25,0

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• High precipitation levels – leaching of nutrients

What prevents nutrient leaching from soils?

Cation exchange capacity

- given by content (amount, type) of clay minerals and humus

Leaching in the tropics affects also silicium (Si; making up for up to 90 % of soil mineral particles).

Result: - reduced Si-content in soil
- formation of **fersialitic** and **feralitic** soils.

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Number of exchange units per 100 g clay or humus:

Montmorillonites	80 – 150
Chlorites, vermicullites	15 – 40
Kaolinites	3 – 15
Humus	**150 – 500**

In the tropics, humus substances are limited to upper 20-30 cm to soil;
humus content is low (fast mineralization): 1-2 (max. 3) %

Temperature of topsoil in the tropics: 28-30 ºC
Decomposition rate increases fourfold when temperature rises from 20 to 30 ºC
Complete decomposition of organic matter in 9 month (in the temperate zone years)

Despite of this, highest CEC in the upper soil layer of tropical soils:
2 g / cm^3 specific mass
40 % kaolinite, 2 % humus – humus contributes 2:1 to total CEC!

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Effect of slash and burn agriculture:

Nutrients are mobilized from the ash
Part of humus destroyed by burning

→ **Nutrient loss by leaching**

By the 2nd harvest the rest of soil humus has been decomposed, little input, no humus regeneration.
If fertilizer is added it runs through the soil (low CEC)

The saprotrofic food chain in terrestrial ecosystems : Soil

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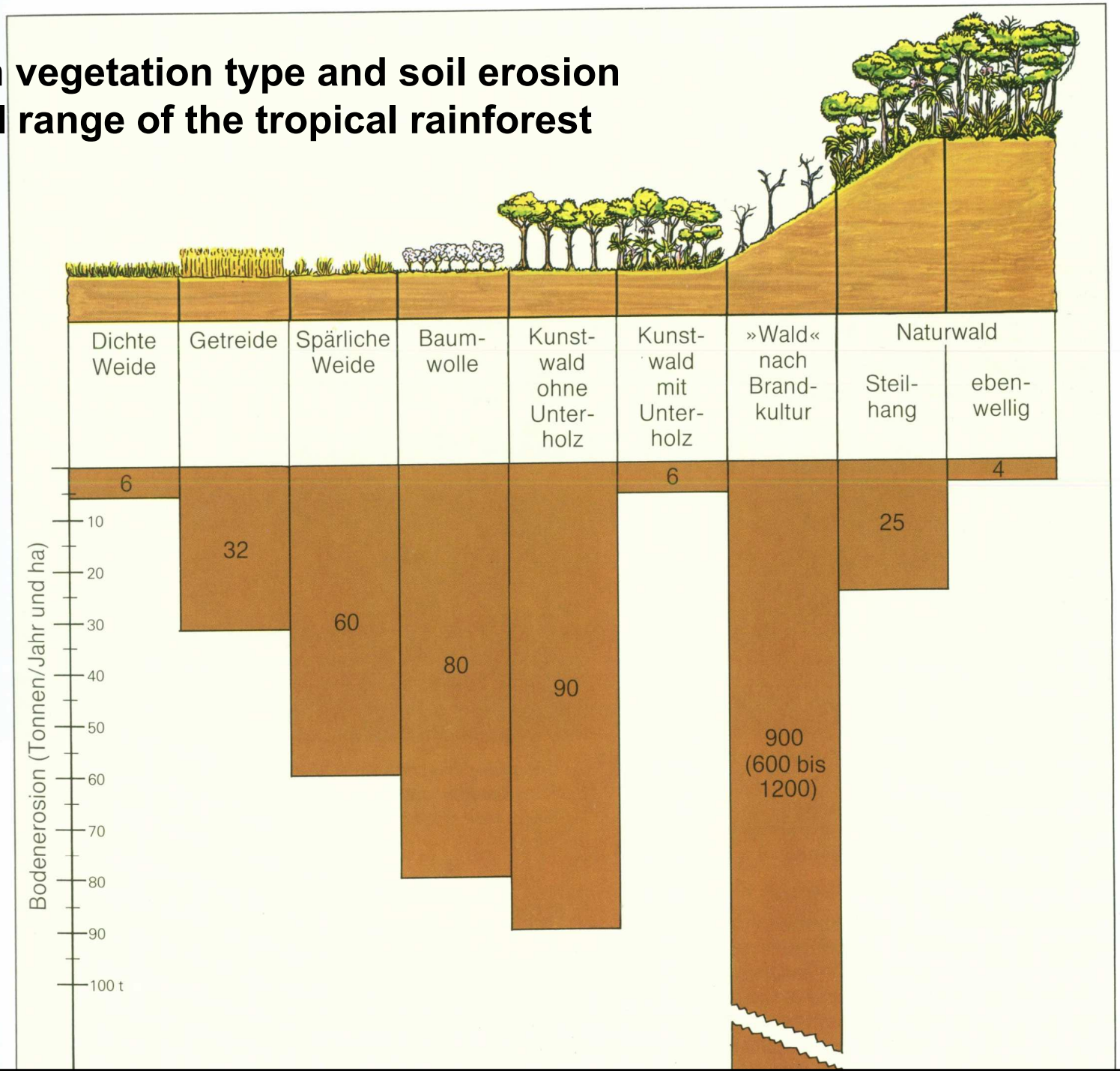
Relation between vegetation type and soil erosion within the natural range of the tropical rainforest



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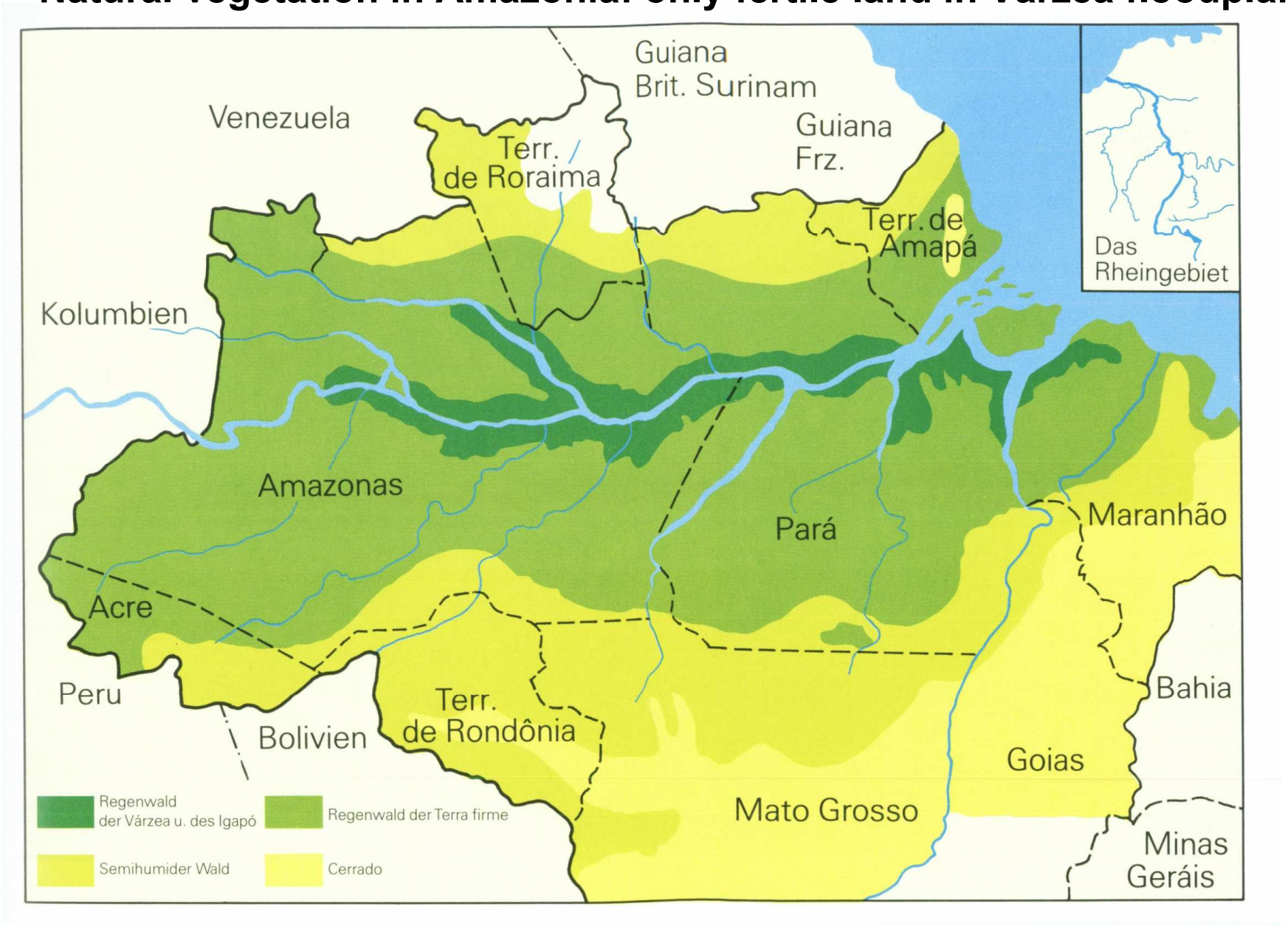
Natural vegetation in Amazonia: only fertile land in Varzea floodplains



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Why is there such a lush vegetation in the tropics, then?!

- Almost all nutrients in the live biomass (some in SOM)
- Direct mineral cycling
- The vegetation functions as a filter: several storeys, epiphytes, concentration of roots in the upper 30 cm of soil
- Micorrhiza: nutrient traps, closing link (shortcut in the nutrient cycle!)

- Nutrients have accumulated over hundreds of years (100-200 years) without forest fires (humidity!), also due to weathering.
- The poorer the parent rock the longer the regenetration time.

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