Magnesium in Crop Production, Food Quality and Human Health

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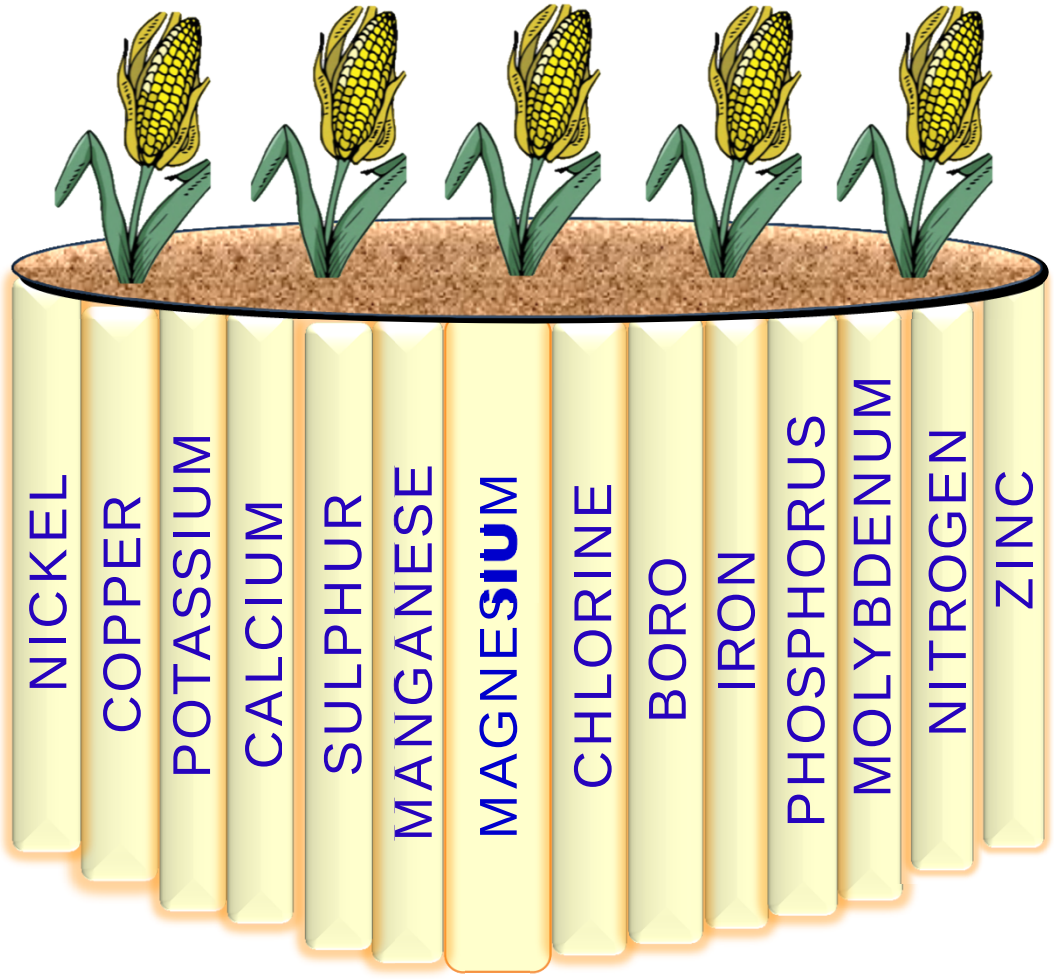
SUSTAINABLE PRODUCTIVITY OF CROPS AND THE EFFICIENT USE OF NUTRIENTS



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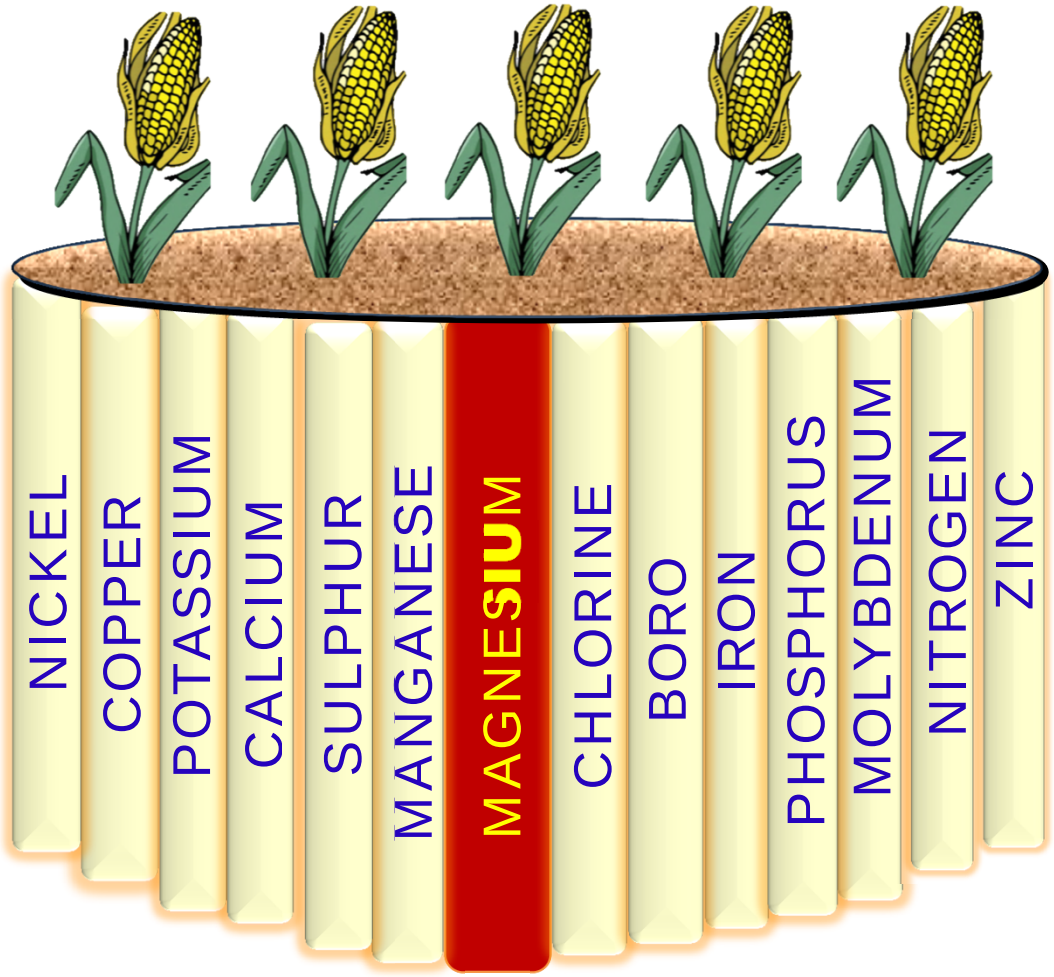

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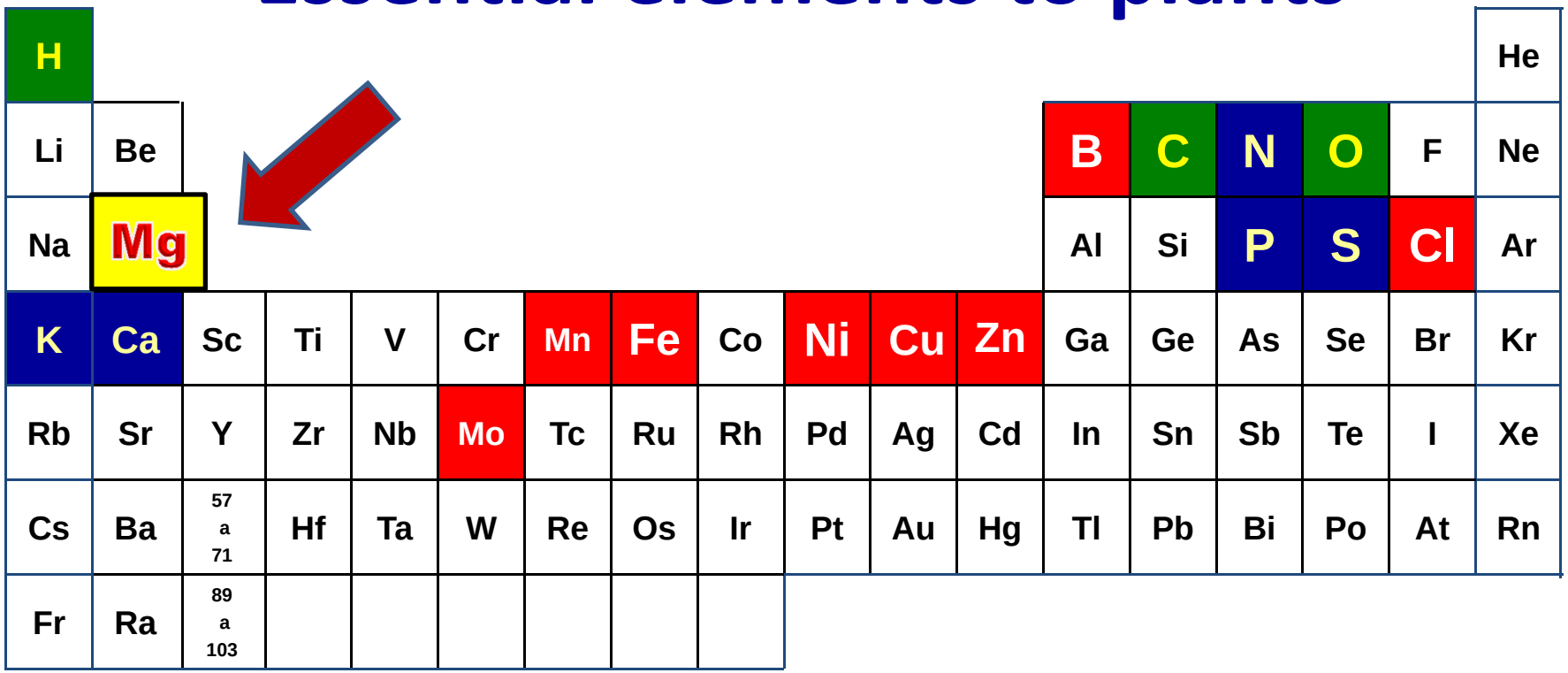
Essential elements to plants



Watter
90 to 95% of fresh matter

macronutrients
0.5 to 100 $g.kg^{-1}$

micronutrient
<500 mg g^{-1}

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BRAZIL: POWER WORLD AGRICULTURAL

PRODUCT	PRODUCER	EXPORTER
Coffee	1º 	1º
Sugar cane	1º 	1º
Orange juice	1º 	1º
Meat	1º 	1º
Soya complex	2º 	1º
Poultry	2º 	1º
Cotton	6º 	3º

SOURCE: FAO/USDA, MAPA

Foreign Trade

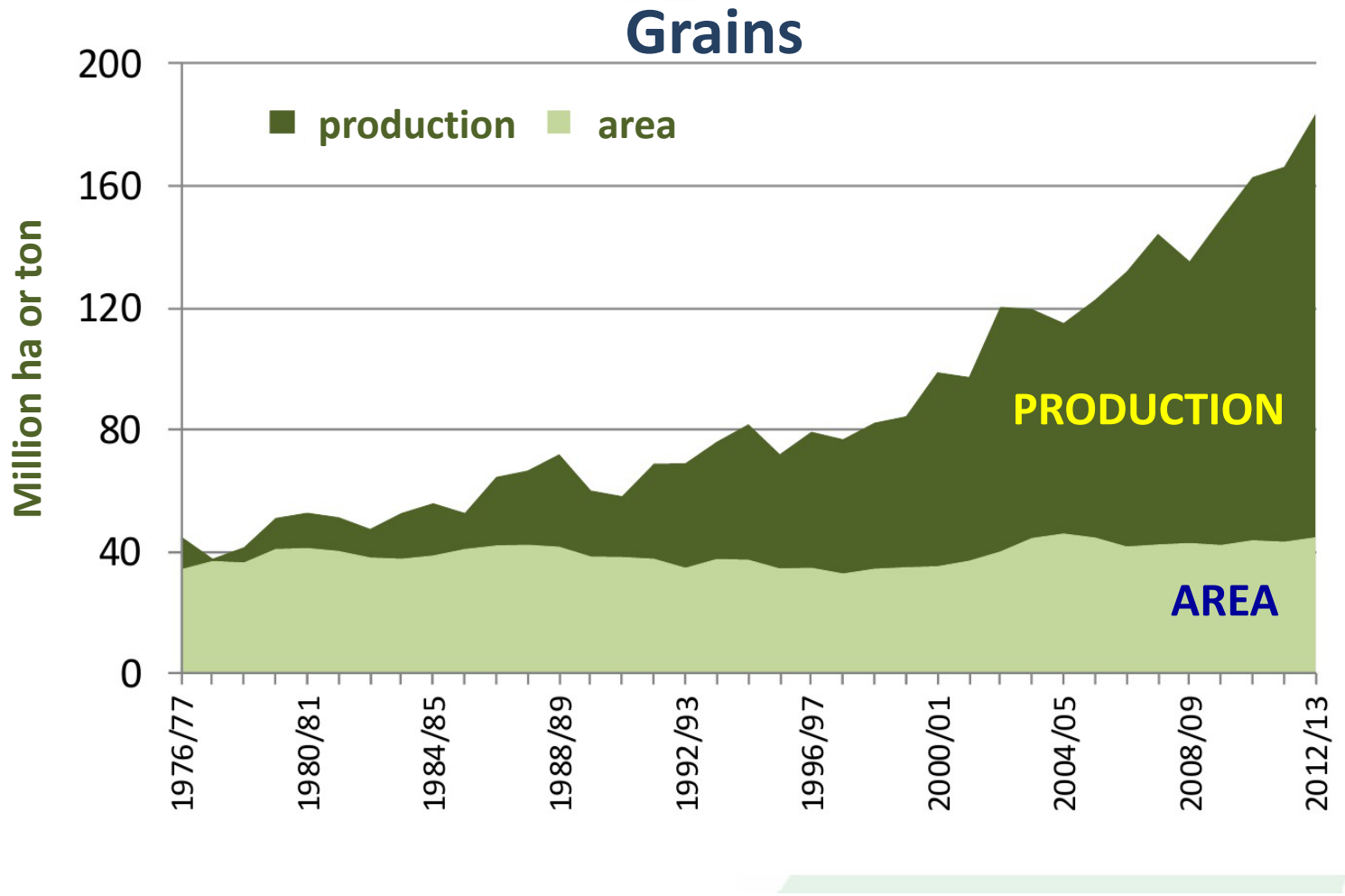
US$83 billion

Exporter to 212 DESTINATIONS

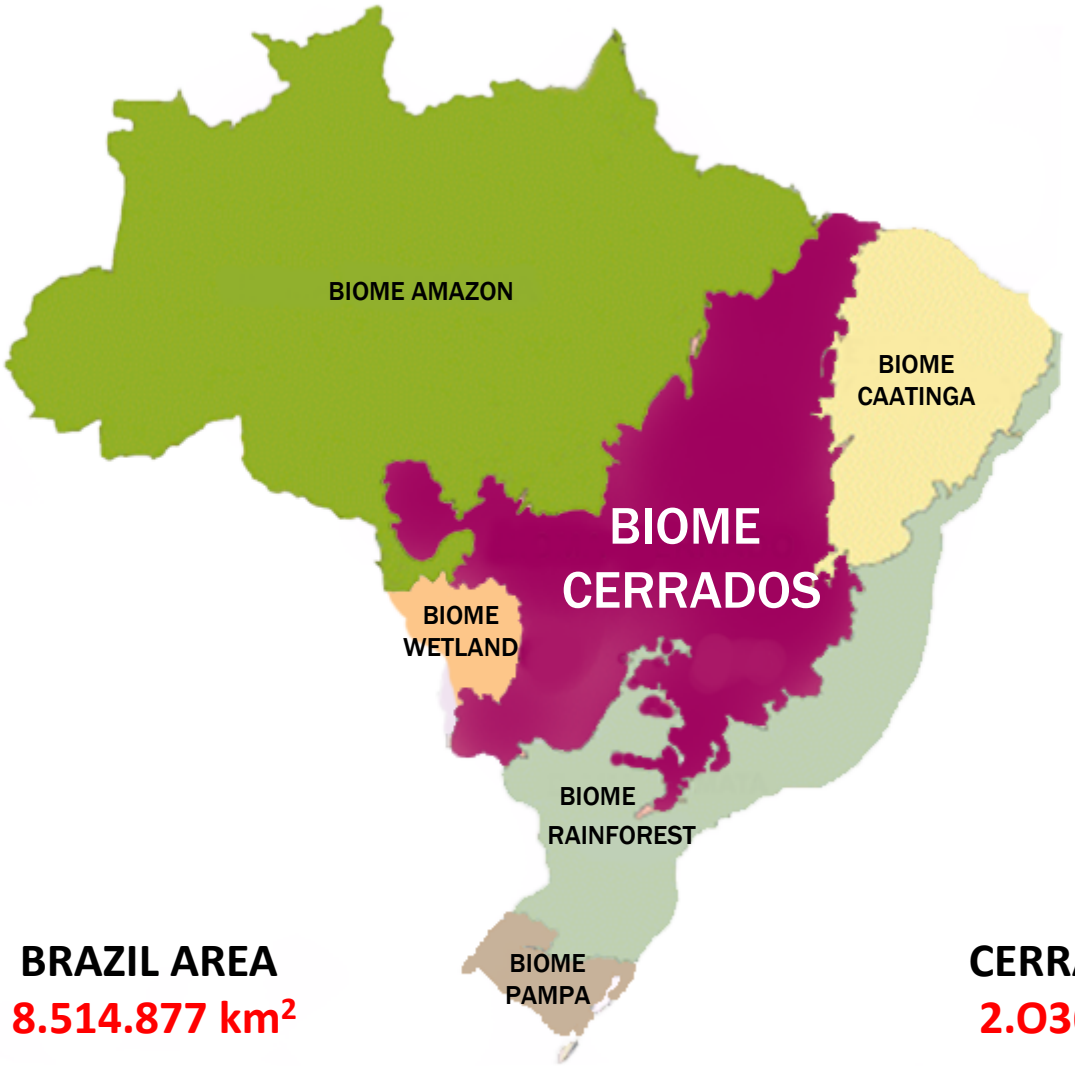
1960 BRAZIL
Importer
FOOD

2014 BRAZIL

DEVELOPMENTS IN PRODUCTION AND AREA PLANTED TO GRAINS IN BRAZIL



Source: CONAB, Agro MD



BRAZIL AREA
8.514.877 km²

CERRADO AREA
2.O36.448 km²

Geographic Extent and Principal Limitations for Regions Soil Acids, Infertile in Tropical America (Sanchez & Salinas, 1981)

LIMITATIONS	MILLIONS ha	% OF TOTAL AREA
PHYSICAL		
Lack of Rain (> 3 months)	299	29
CHEMICAL		
P deficiency	1002	96
Effective low CEC	577	55
Zn deficiency	645	62
High P fixation	672	74

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Chemical Characteristics of 518 Samples of Soils under Cerrado in Brazil (Lopes, 1975)

Chemical Characteristics	Critical Level	Low the Critical Level (%) (A)
pH (H_2O)	5.0	48
Ca exc. ($cmol_c.dm^{-3}$)	1.5	96
Mg exc. ($cmol_c.dm^{-3}$)	0.5	90
Al exc. ($cmol_c.dm^{-3}$)	0.25	91 (B)
P sol. ($mg.kg^{-1}$) (C)	10	99
Zn sol. ($mg.kg^{-1}$) (C)	1.0	95

(A) According to laboratory soil analysis for Minas Gerais.
(B) Above the critical level (%).
(C) Extracted by HCl 0.05 N + H_2SO_4 0.025 N.

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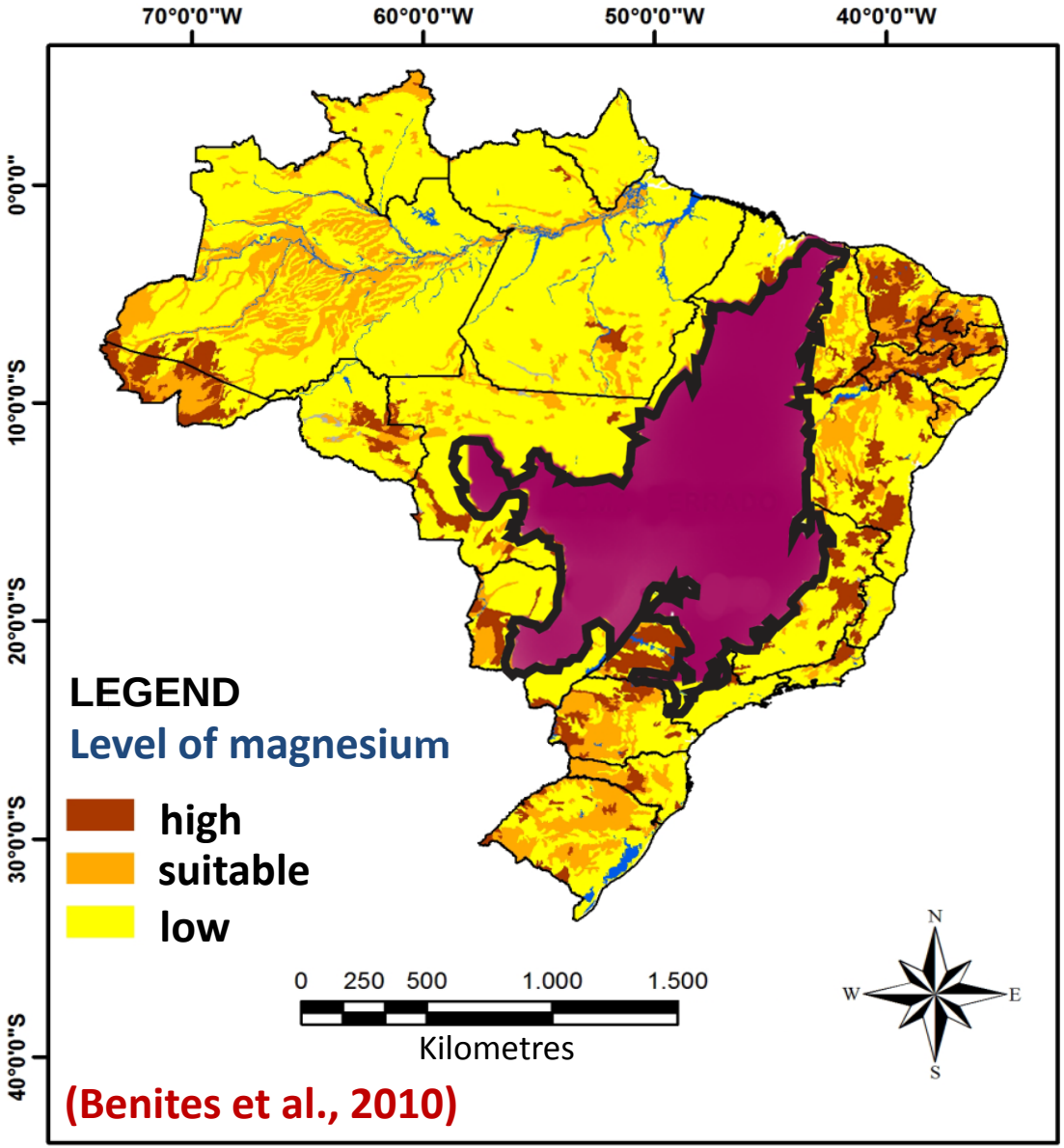
Exchangeable magnesium in the 0-30 cm layer



(Benites et al., 2010)

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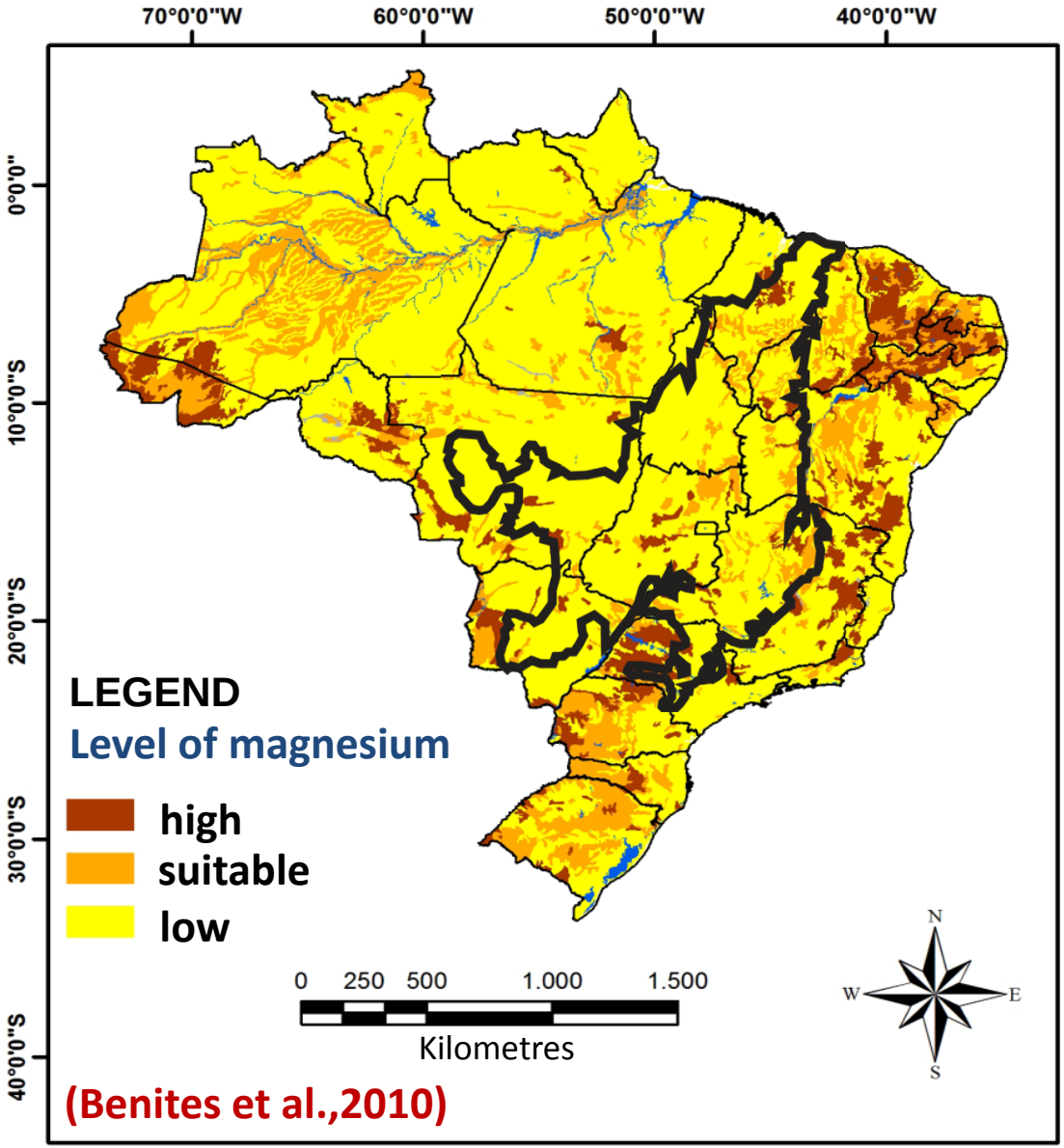
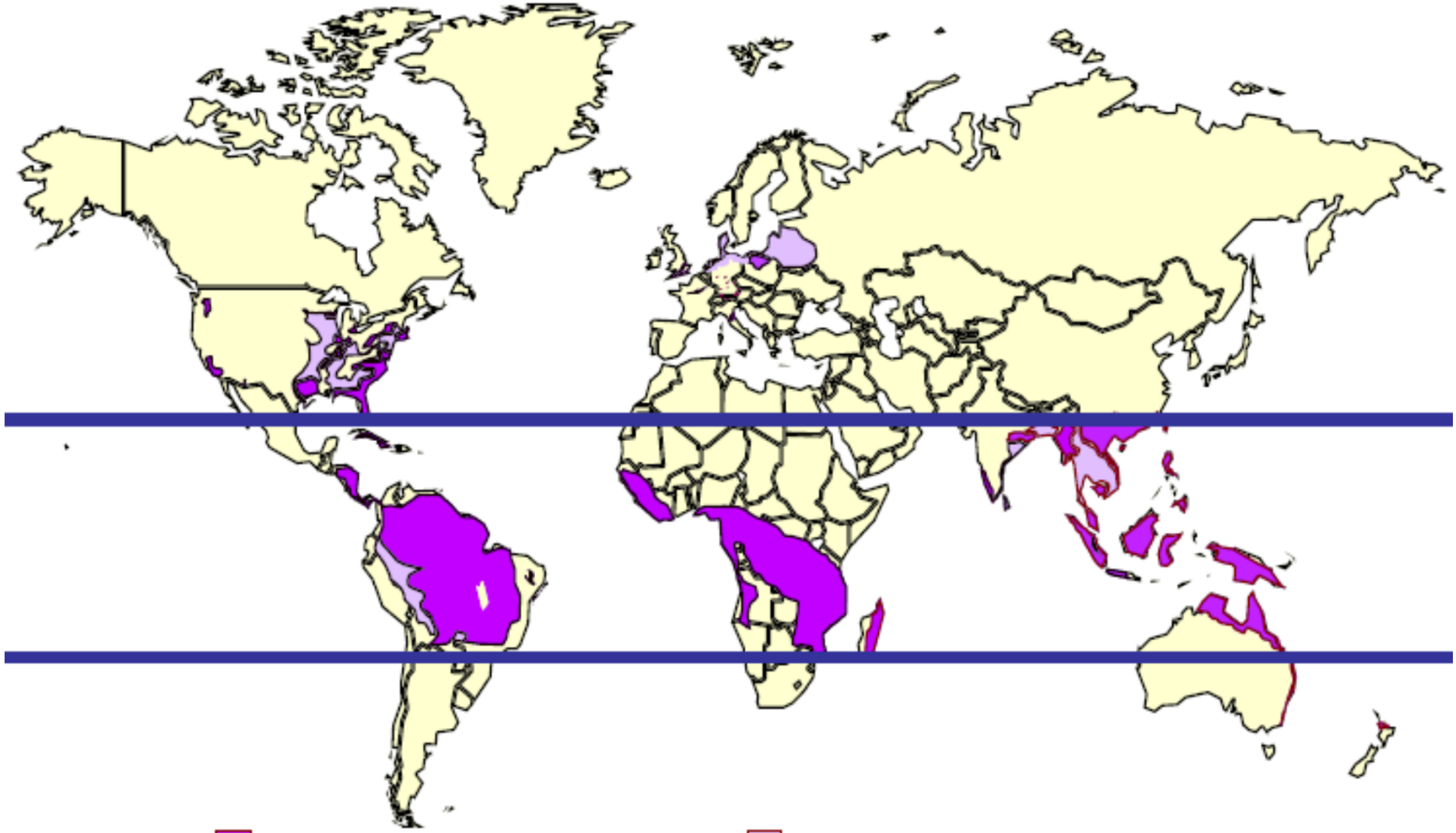


Regions with identified magnesium weaknesses



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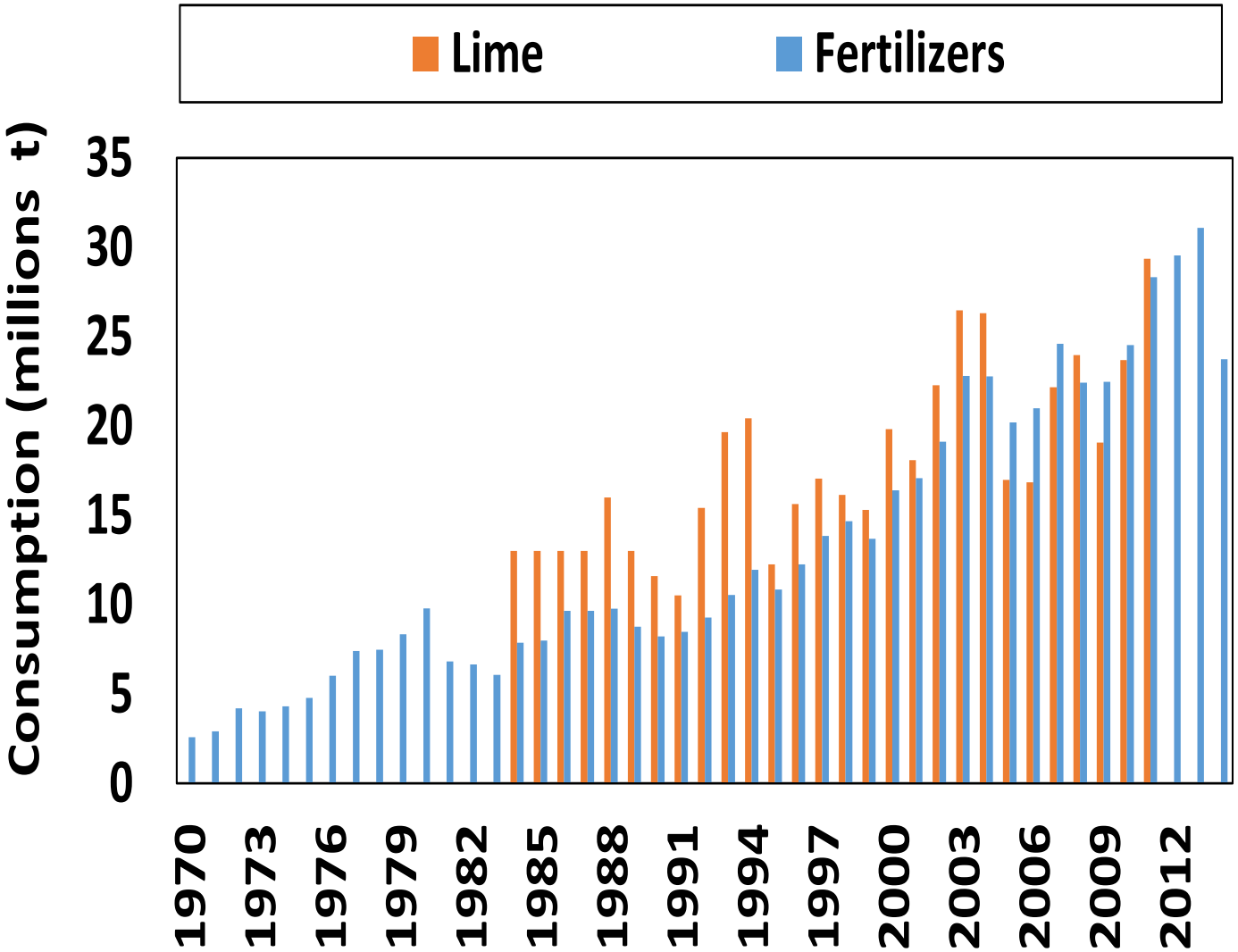
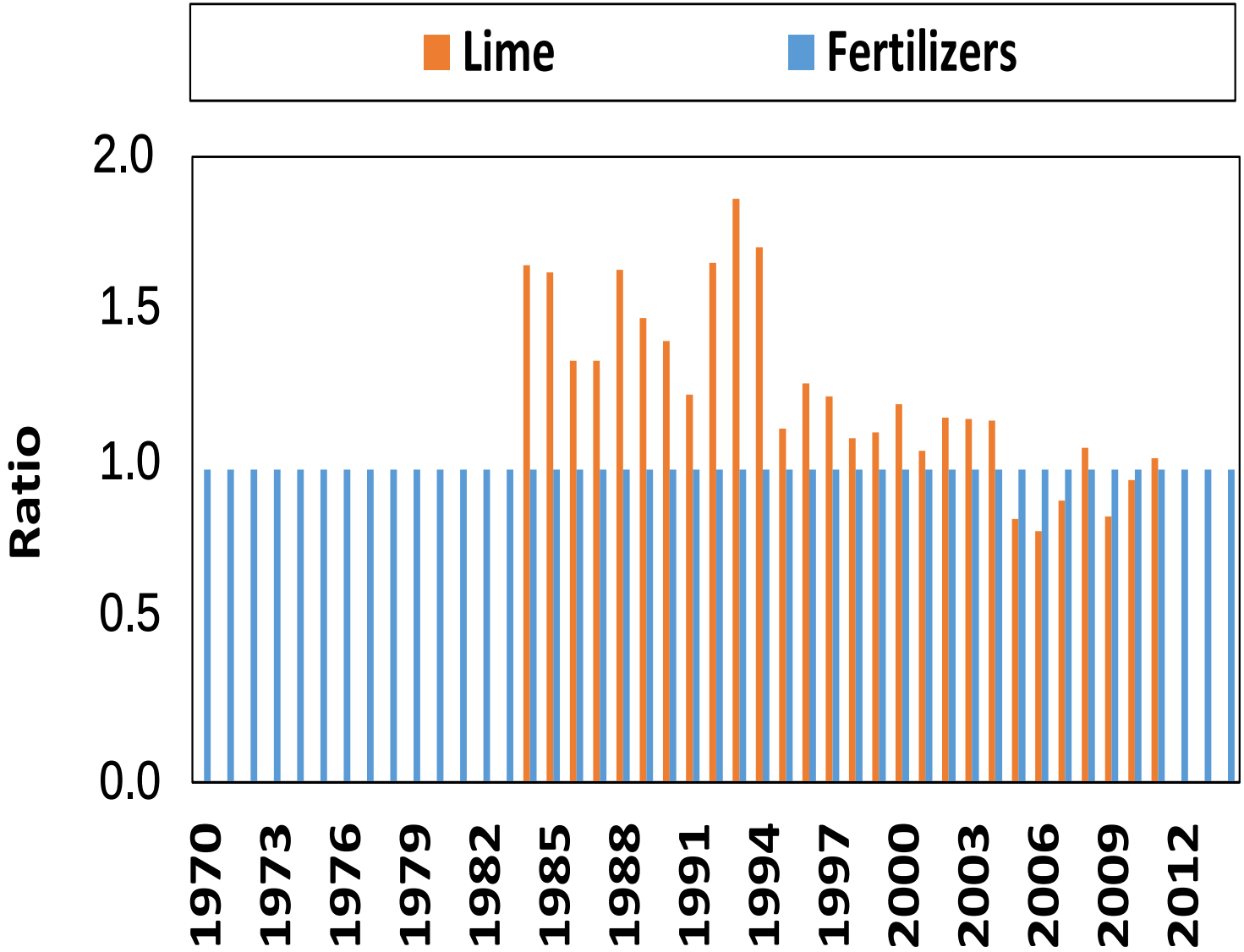
Consumption of fertilizers and lime in Brazil



Source: IPEA, IPLAN, IGBE, MAP, ANDA ABRACAL and GAPE, 2014

Relation of consumption of fertilizers and lime in Brazil



Source: IPEA, IPLAN, IGBE, MAP, ANDA ABRACAL and GAPE, 2014

The importance of magnesium in mineral plant nutrition

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Relegated importance of Mg

Widespread deficiency

More careful in fertilization with Mg

Essential nutrient:

Photosynthesis

Enzyme activity

Carbohydrate transport

Stability of ribosomes

Resistance to toxic aluminum

CO_2 fixation

Use the stored energy

Improves the absorption of phosphorus

Resistance to diseases

Well nourished plants → more resistance, because the metabolism is running smoothly

Photosynthesis energy is required for some defense mechanisms

Mg excess may cause indirectly diseases such as blossom end rot in tomatoes

Resistance to diseases

Carbohydrates in the leaves can attract pathogen

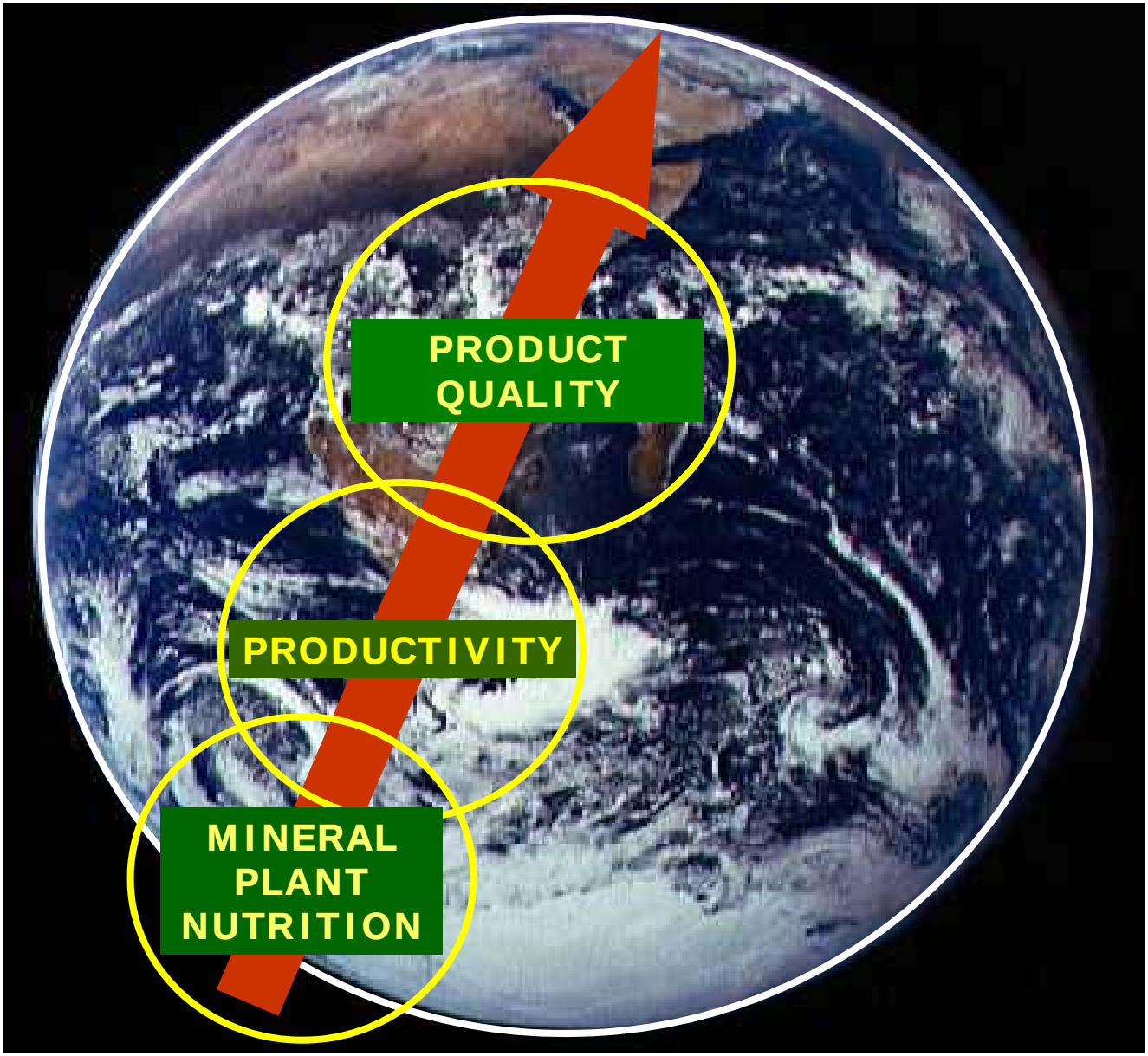
Chelating molecules glyphosate

Fighting pastures tetany in ruminants

In relation to human nutrition, protects against cardio-vascular disease, diabetes and stroke

May help fight high human intake of sodium (Na)

SUSTAINABILITY



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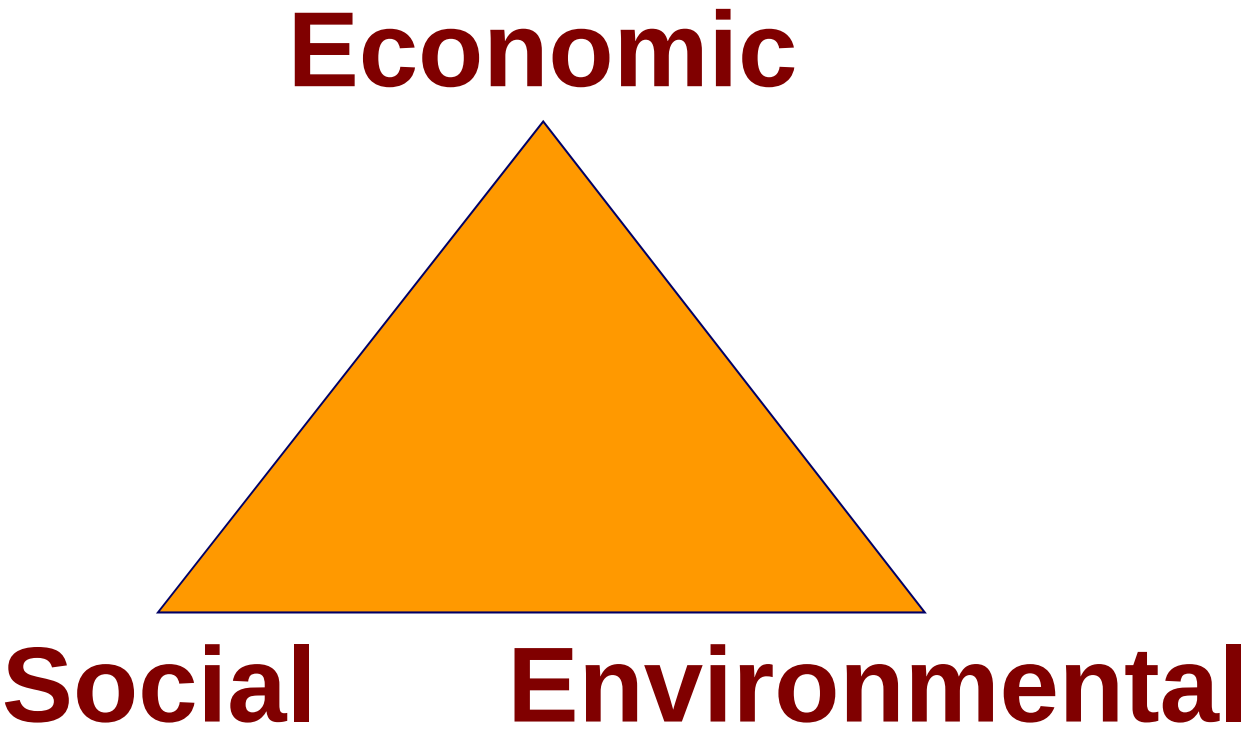
SUSTAINABILITY
THE TRIPLE BOTTOM LINE



Source: Report Brundtland (ONU, 1987)

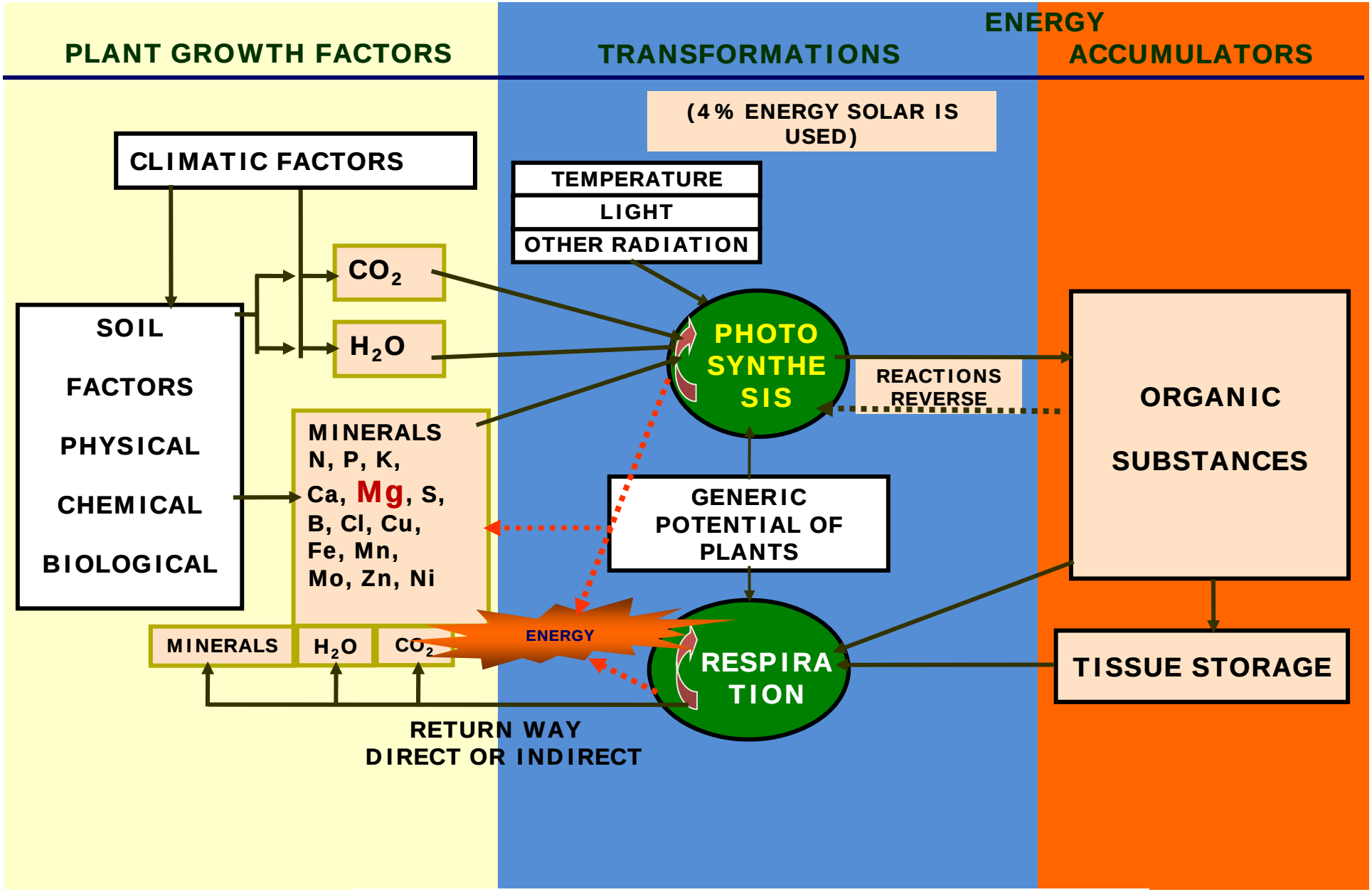
Plant Biochemistry

Reactions complex system in which the minerals are essential

Participate in composition, regulation and catalysis

Tissue reactions and products

SIMPLIFIED SCHEME OF PRODUCTION OF ORGANIC SUBSTANCES IN PLANTS



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(Bergmann & Neubert, 1976), Modified DEON, 2006

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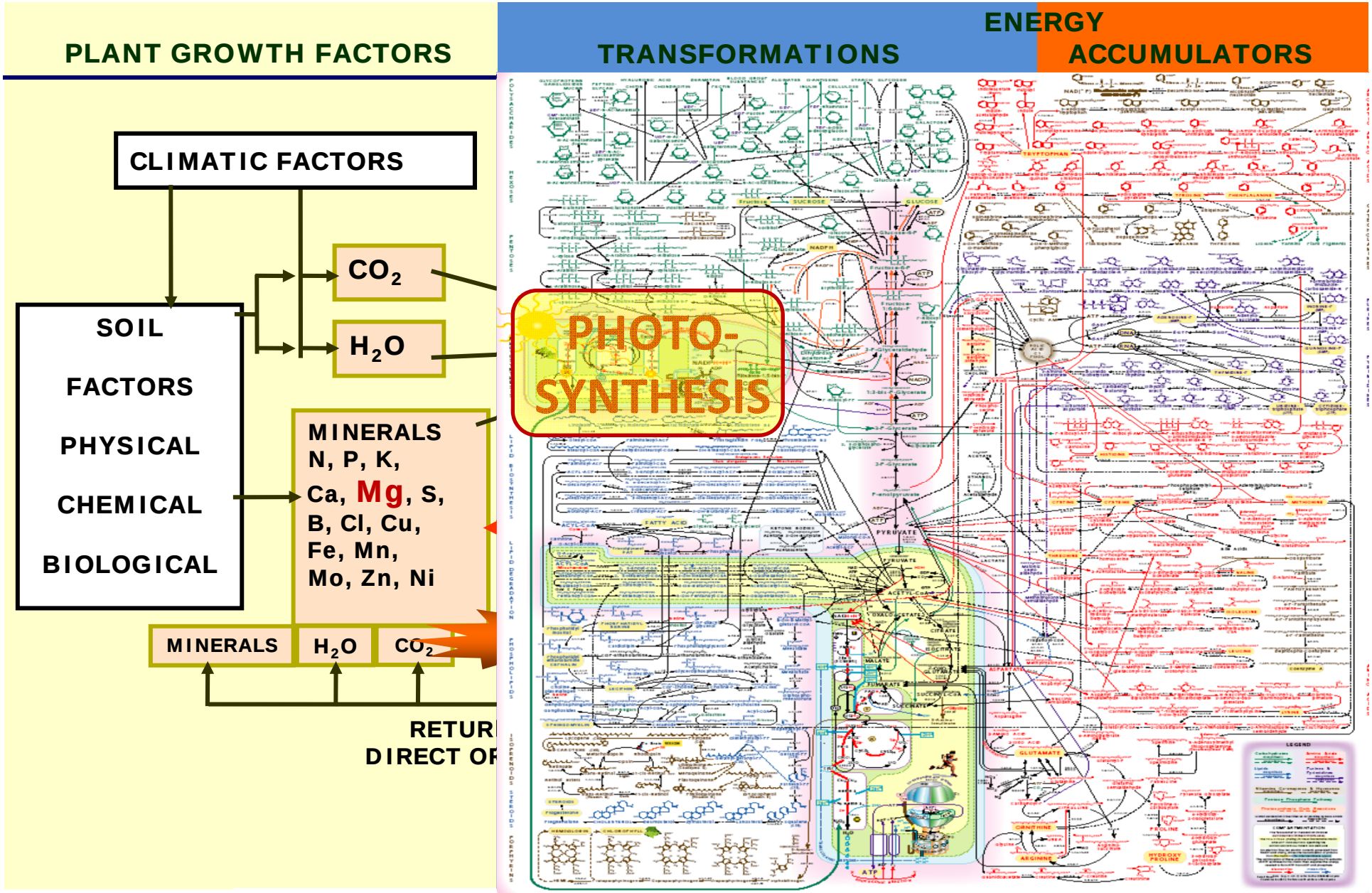

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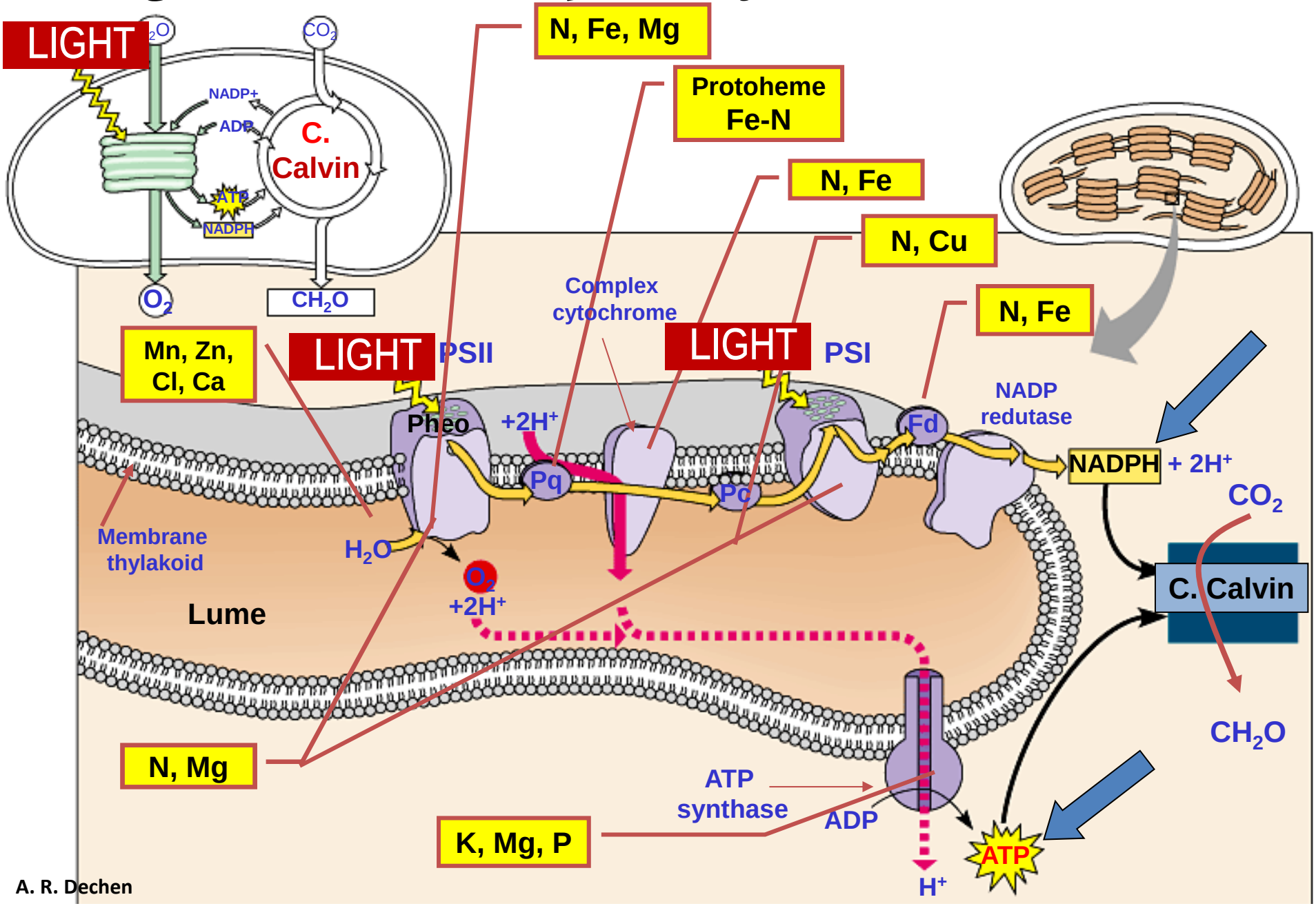
Plant Biochemistry

An example:

nutrients in the reactions

photosynthesis

Light reactions of photosynthesis - nutrients



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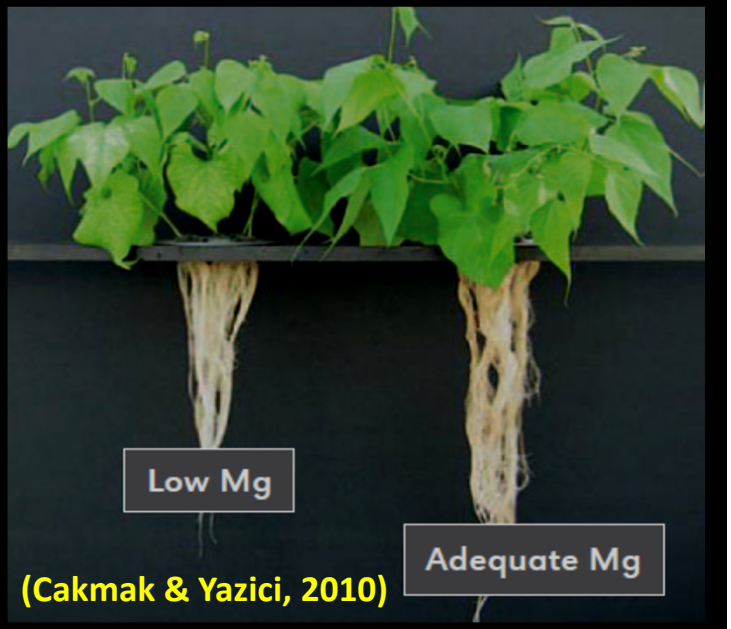
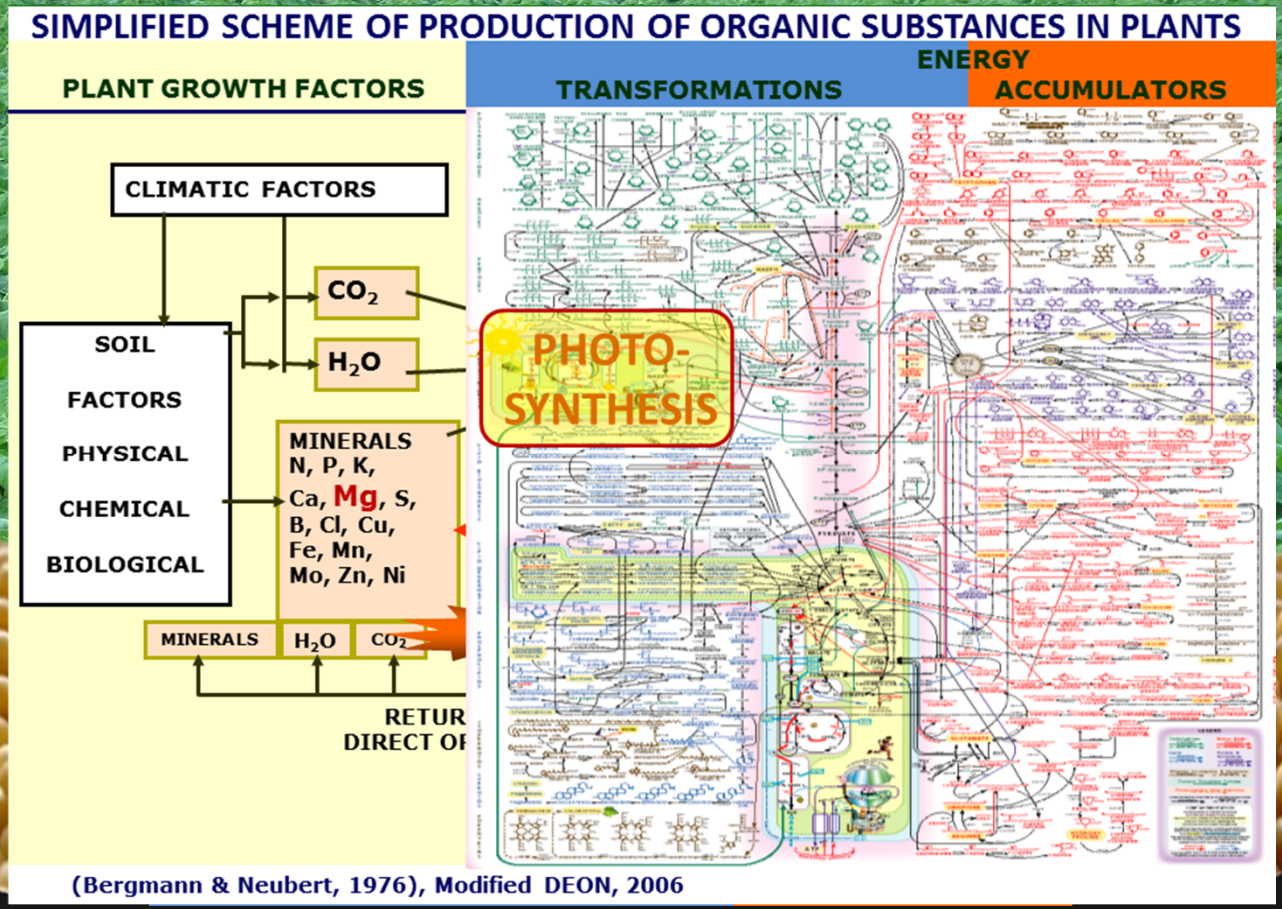
Plant Biochemistry

- **Problems in mineral nutrition cause chain reaction of damage to the operation of the plant:**


Low Mg
Adequate Mg
(Cakmak & Yazici, 2010)


SIMPLIFIED SCHEME OF PRODUCTION OF ORGANIC SUBSTANCES IN PLANTS
PLANT GROWTH FACTORS
TRANSFORMATIONS
ENERGY ACCUMULATORS
CLIMATIC FACTORS
SOIL FACTORS
PHYSICAL
CHEMICAL
BIOLOGICAL
CO2
H2O
MINERALS N, P, K, Ca, Mg, S, B, Cl, Cu, Fe, Mn, Mo, Zn, Ni
PHOTO-SYNTHESIS
MINERALS
H2O
CO2
RETUR
DIRECT OF
(Bergmann & Neubert, 1976), Modified DEON, 2006

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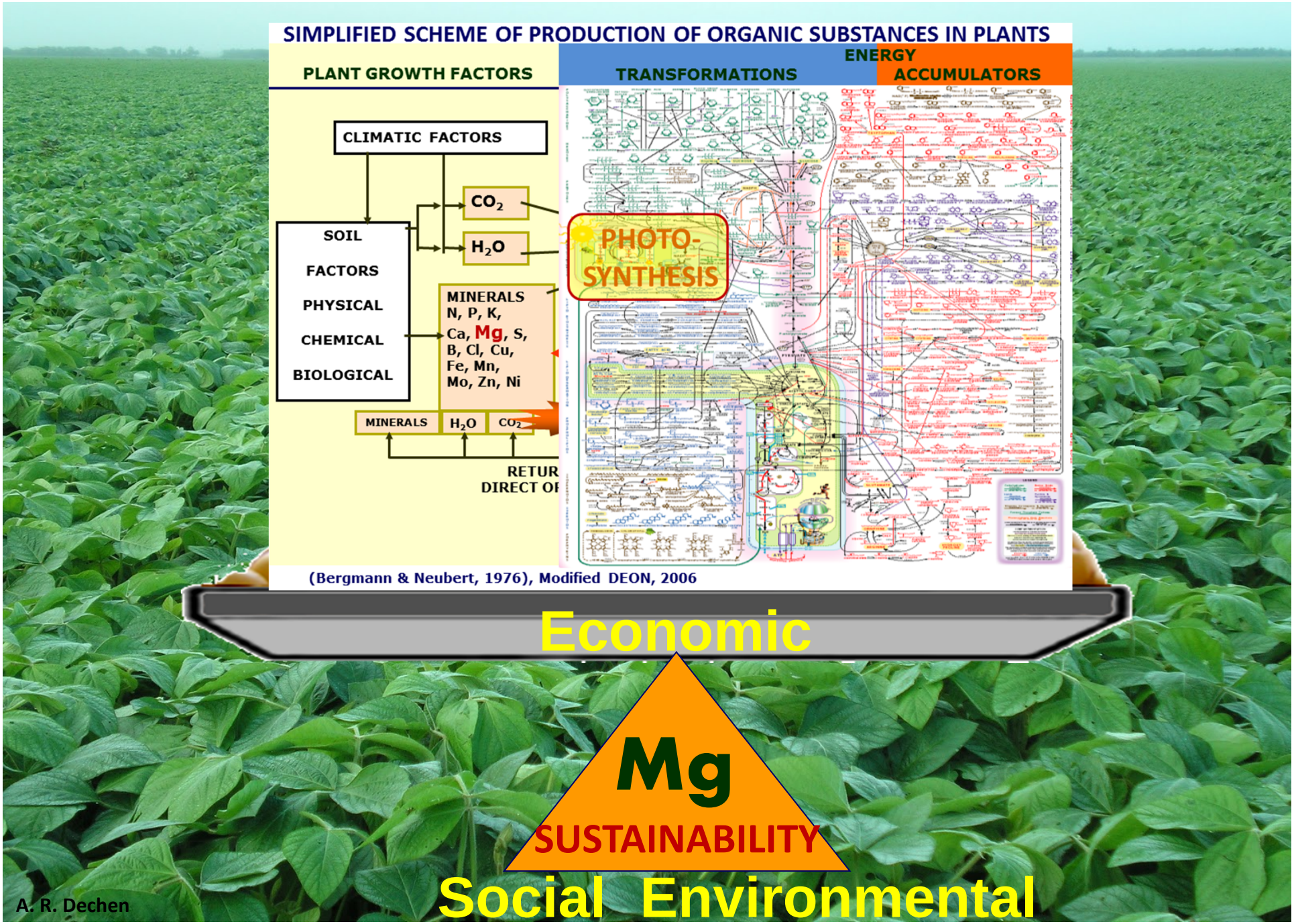
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PLANT GROWTH FACTORS
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SOIL FACTORS
PHYSICAL
CHEMICAL
BIOLOGICAL
CO_2
H_2O
MINERALS
N, P, K,
Ca, Mg, S,
B, Cl, Cu,
Fe, Mn,
Mo, Zn, Ni
PHOTO-SYNTHESIS
MINERALS
H_2O
CO_2
RETUR
DIRECT OF
(Bergmann & Neubert, 1976), Modified DEON, 2006
Economic
Mg
SUSTAINABILITY
Social
Environmental
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"You Cannot Build Peace on Empty Stomachs…"

John Boyd Orr (First FAO Director General)

Norman Borlaug

Father of the Green Revolution

Nobel Peace Prize 1970

The game ended without fertilizer


WELCOME TO BRAZIL
THANK YOU