



AGROECOLOGY

AN AGRICULTURAL SCIENCE AND PRACTICE FOR SMALL-SCALE FARMERS IN SUB-SAHARAN AFRICA

LECTURER

- Kim Schneider, Agricultural Engineer, Project Manager
- Swiss foundation committed to scientific research and the dissemination of innovative and accessible technological, economic and medical solutions



The Agroecology Unit



RESEARCH AND DEVELOPMENT OF PRODUCTIVE AND SUSTAINABLE AGROECOSYSTEMS

Attempt to replicate the stability of a natural ecosystem with food crops and productive animals.

- Positive interactions between crops
- Positive interactions with predatory and pollinating insects
- Negative interactions towards weeds and pests
- Resilience of the system due to a wide biodiversity
- Management of resources (water and nutrients) in a closed circuit

RESEARCH AND DEVELOPMENT OF PRODUCTIVE AND SUSTAINABLE AGROECOSYSTEMS

An Agroecosystemic model is a design/plan of a farm

This farm can produce intensively and sustainably on a small area all commodities needed for subsistence (Vegetables, Cereals, Fruits, Animals, Cash crops)

The farm produces without the use of synthetic and external pesticides and fertilizers

The animals produce the necessary manure for the farm (in addition to compost and green manure)

The small size of the farm correspond to the mean area of farms in the target region

RESEARCH AND DEVELOPMENT OF PRODUCTIVE AND SUSTAINABLE AGROECOSYSTEMS

Development of “**Agroecosystemic models**” for different geoclimatic regions of Africa.

The model is created according to the following criterias:

- Type of climate (Koppen classification)
- Length and intensity of rainy season (inside the climate zone)
- Main type of soils
- Commodities usually produced and eaten in the region

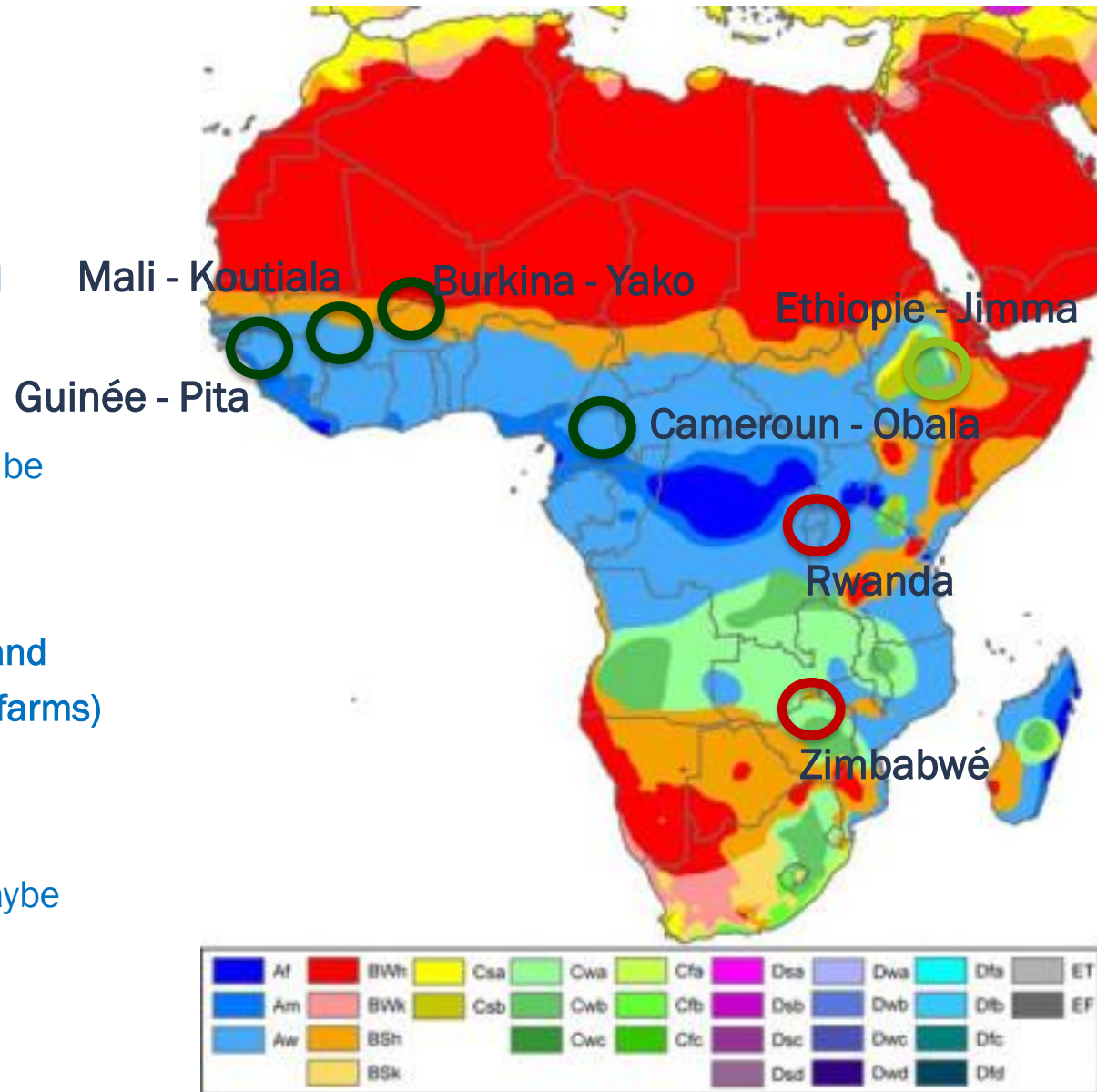
RESEARCH AND DEVELOPMENT OF PRODUCTIVE AND SUSTAINABLE AGROECOSYSTEMS

The model is created in collaboration with the local partner of target zone.

The model combines traditional practices of target zone/country, practices of other countries as well as results of scientific research in agronomy and agroecology.

➤ TODAY

- ✓ 4 complete agroecological farms (mother farms)
- Network of sister farms to be established starting 2022
- ✓ Future farms in Ethiopia and Rwanda (mother + sister farms) in 2022
- ✓ Future farms in 2023, maybe Zimbabwe ?



CHAPTER 1 : INTRODUCTION

- The problems of modern conventional agriculture
- An alternative: agroecology
- Lecture aim and program

PROBLEMS CAUSED BY MODERN AGRICULTURE

- Water pollution
- Endangered human health
- Loss of biodiversity
- Global warming
- Soil degradation

SPECIFIC CAUSES OF THESE PROBLEMS

- Monoculture
- Poor or excessive use of pesticides
- Poor or excessive use of fertilisers
- Excessive greenhouse gas (GHG) emissions
- Erosion and leaching
- Other drivers of soil degradation

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MONOCULTURE

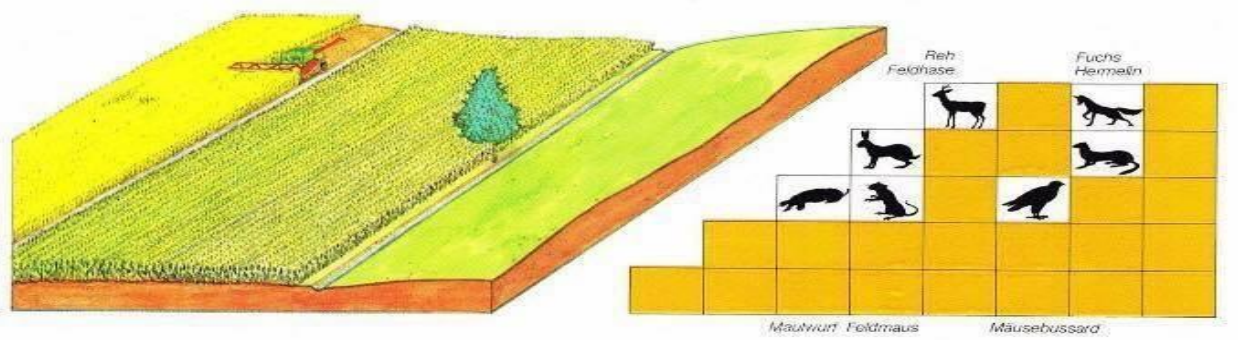
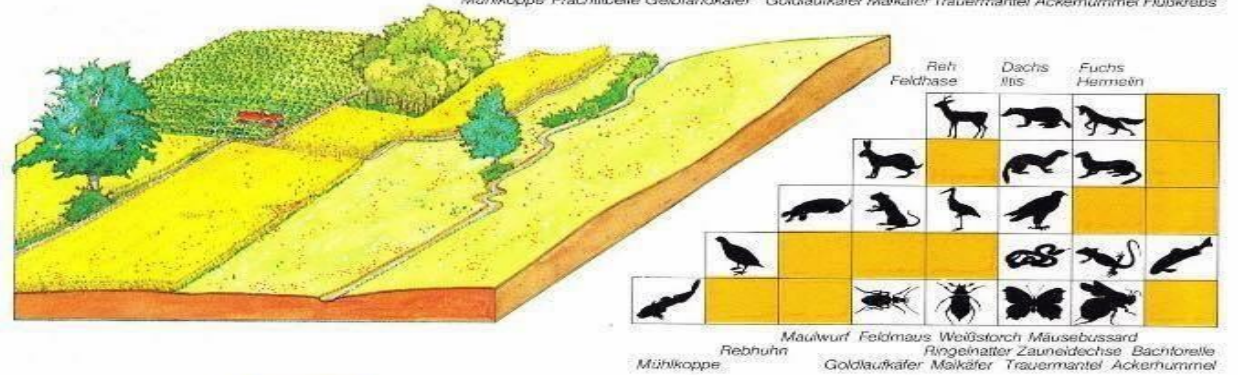
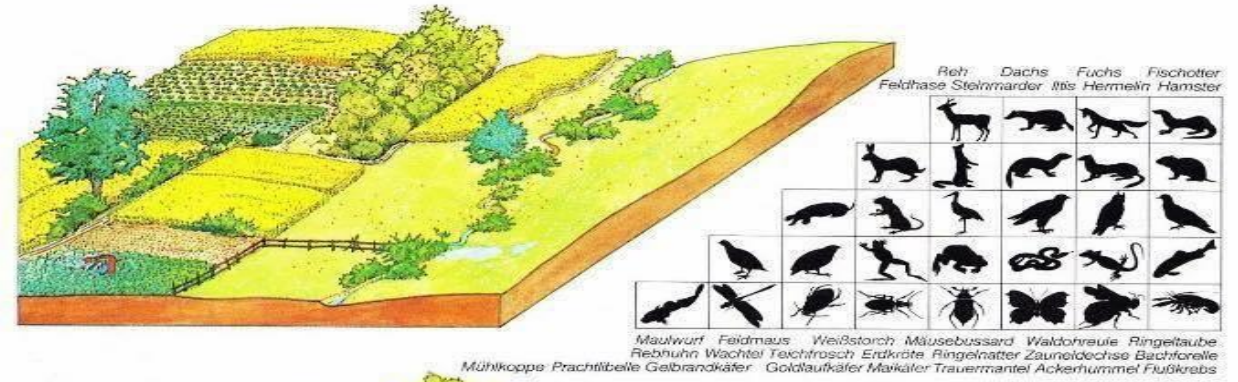
Loss of biodiversity



MONOCULTURE

Loss of biodiversity

- Weak system resilience
- Dependence on pesticides



MONOCULTURE

Loss of biodiversity

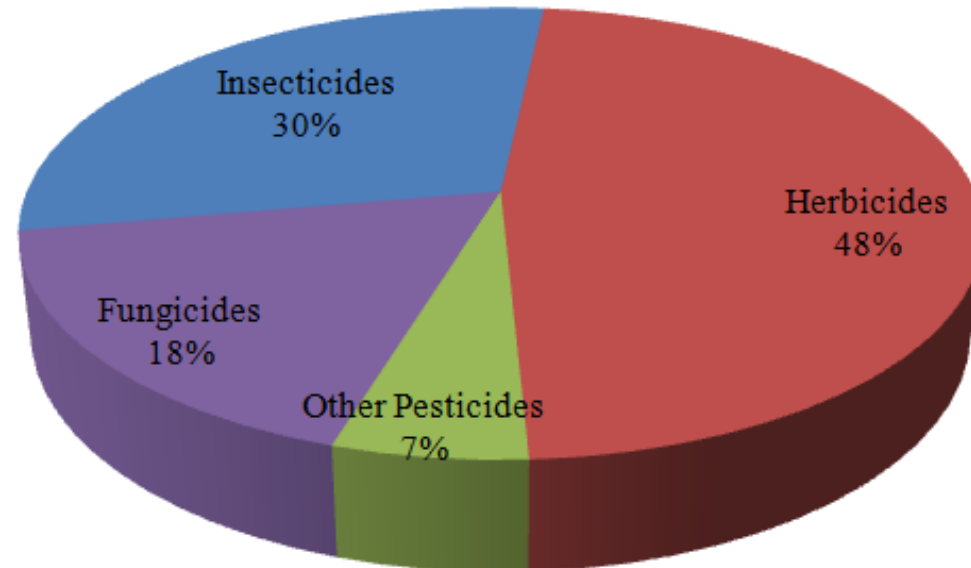
- **Soil depletion**



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POOR OR EXCESSIVE USE OF PESTICIDES

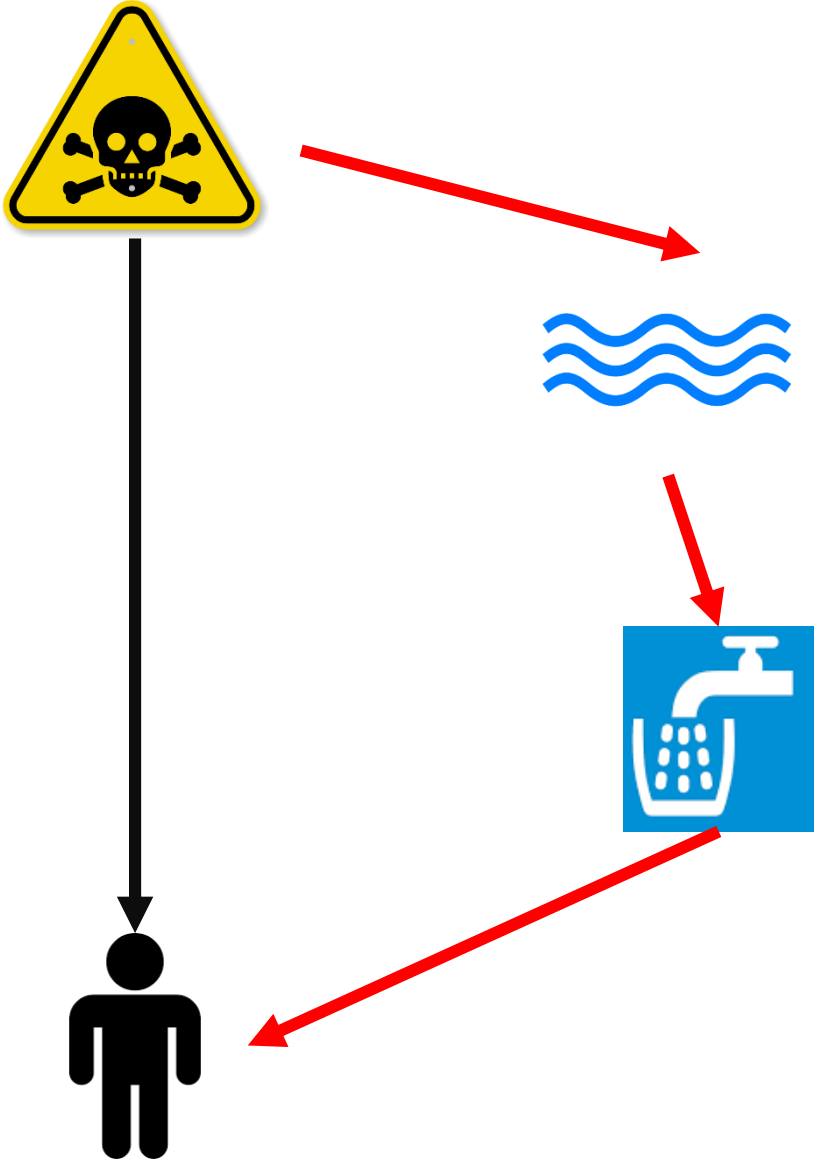


- 45% of global production is lost to pest attacks (Abhilash & Singh, 2009).

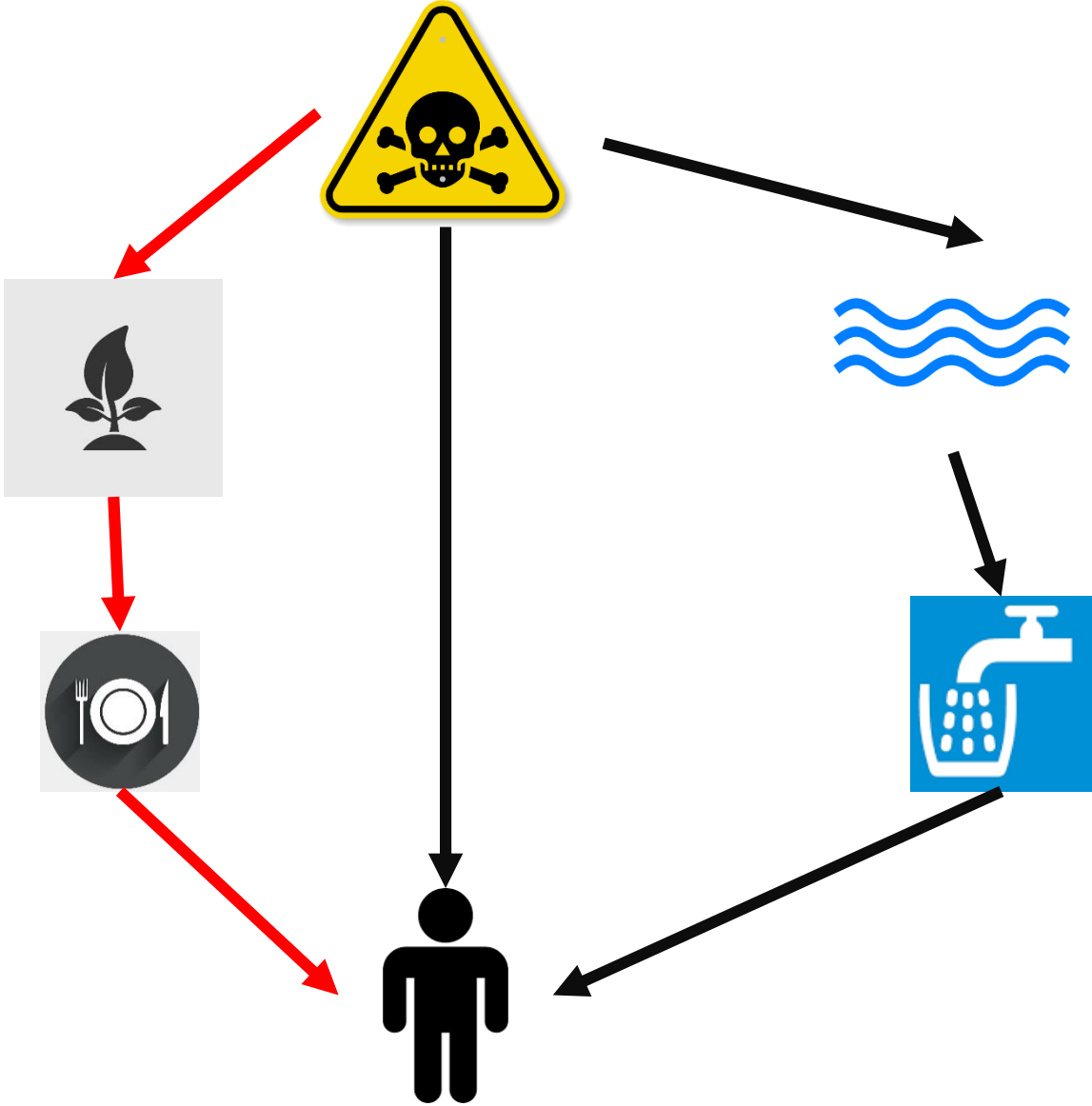
HEALTH PROBLEM



HEALTH PROBLEM



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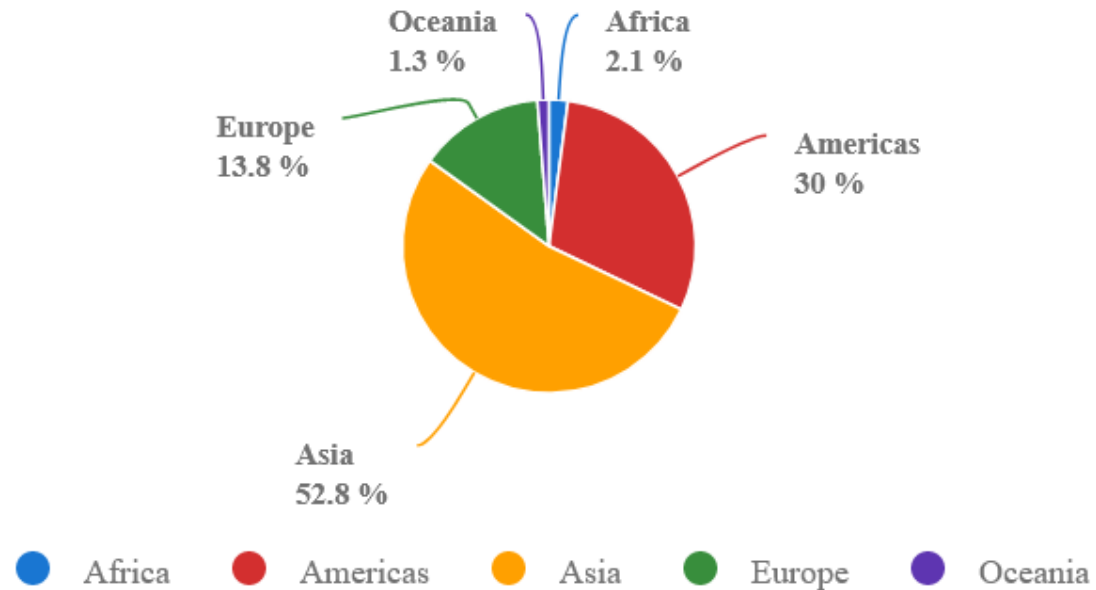


ENVIRONMENTAL PROBLEMS

- Water contamination
- Soil contamination
- Loss of biodiversity

IS THIS A PROBLEM FOR AFRICA?

- Pesticides use by continent
-



- (FAO Stat, 2020)

IS THIS A PROBLEM FOR AFRICA?

1. Waters are still polluted in Africa

Example: Pesticide traces in Lake Victoria make it impossible to sell fish to the EU (Abong'o, Wangiga, Jumba, & Kylin, 2014)

2. Low user awareness

Inappropriate application: risk to user, consumer, and environment

3. Insufficient regulation

4. Use of toxic products prohibited in other parts of the world

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POOR OR EXCESSIVE USE OF FERTILISERS

- Fertilisers are products that contain the nutrients that the plant needs to feed itself.
- Nitrogen (N), Phosphorus (P) and Potassium (K) are the most important nutrients for plants.
- Their contribution allows considerable increases in yield.
- P and K come from mines, while nitrogen is obtained from the atmosphere through a chemical process.

POOR OR EXCESSIVE USE OF FERTILISERS

What problems do they cause?

- They are not toxic like pesticides.
- However, they can be washed into rivers and lakes, where they cause EUTROPHICATION.



POOR OR EXCESSIVE USE OF FERTILISERS

What problems do they cause?

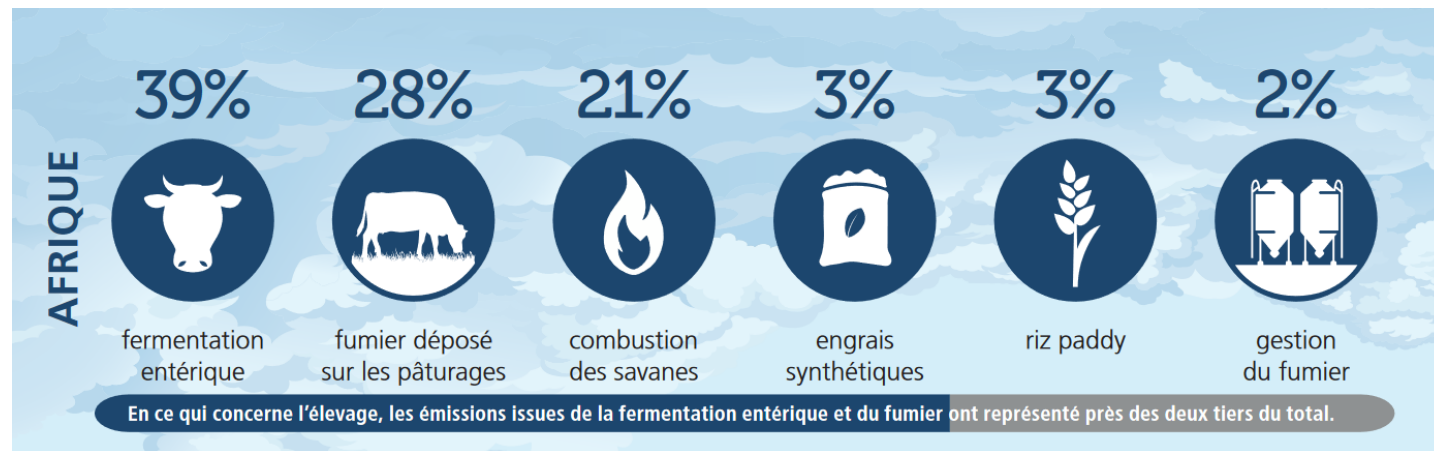
Production of nitrogen fertilizers (N)

- energy consuming (1-2L gasoline/kg N)
- polluting (8.6kg CO₂-equ/kg N)

12% of the world's emissions from agriculture are caused by the production of nitrogen fertilizers.

IS THIS A PROBLEM FOR AFRICA?

- Low fertiliser use in Africa makes the problem of water eutrophication marginal.
- The share of African emissions due to synthetic fertilizer production is only 3%.

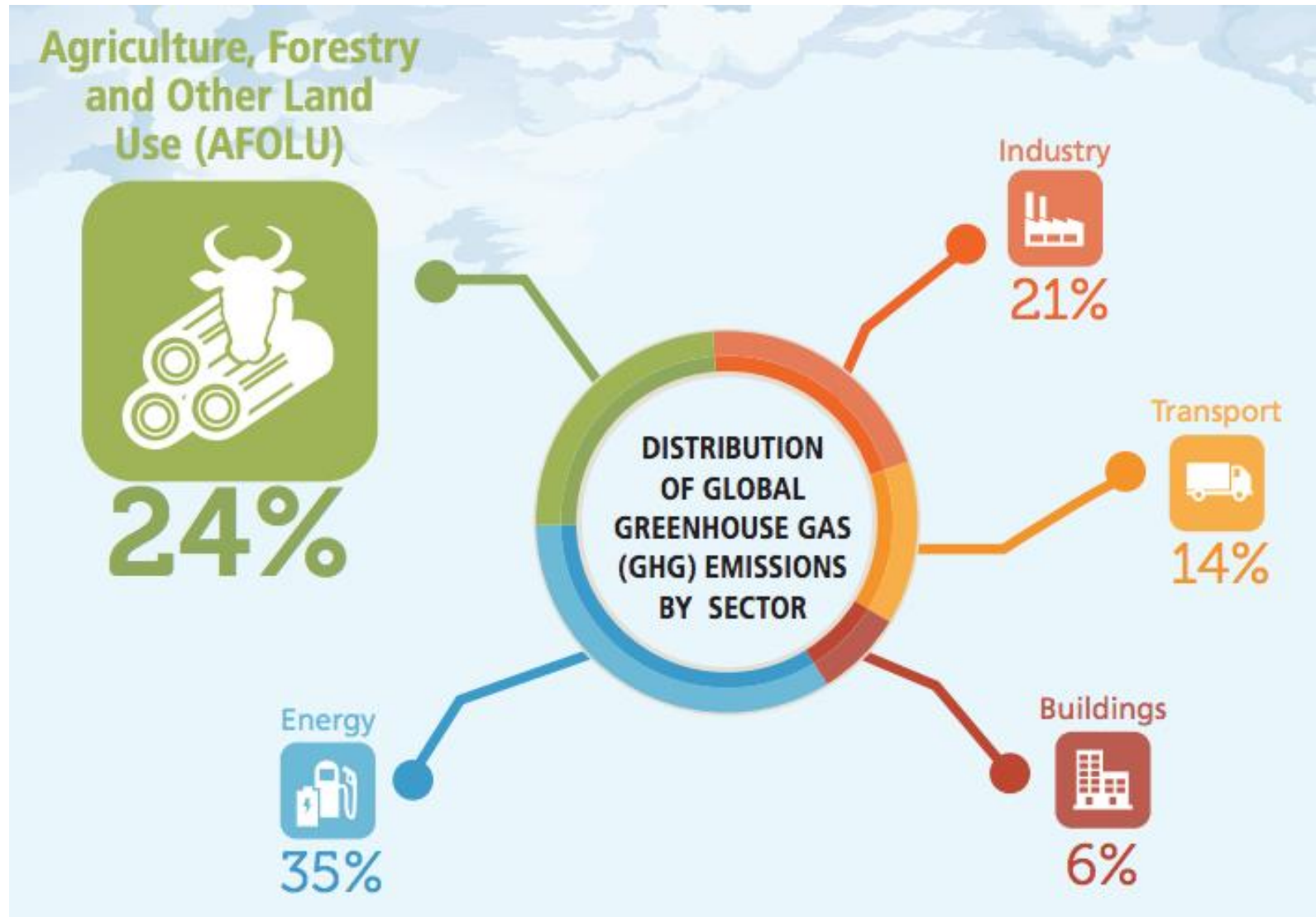


- BUT: cost of fertiliser is too high for many African producers
→ Alternatives needed

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GREENHOUSE GAS EMISSIONS (GHG)



GREENHOUSE GAS EMISSIONS from agriculture, forestry and other land uses (FAO, 2016)

CAUSES

MONDE

40%



fermentation
entérique

16%



fumier déposé
sur les pâturages

12%



engrais
synthétiques

10%



riz
paddy

7%



gestion
du fumier

5%

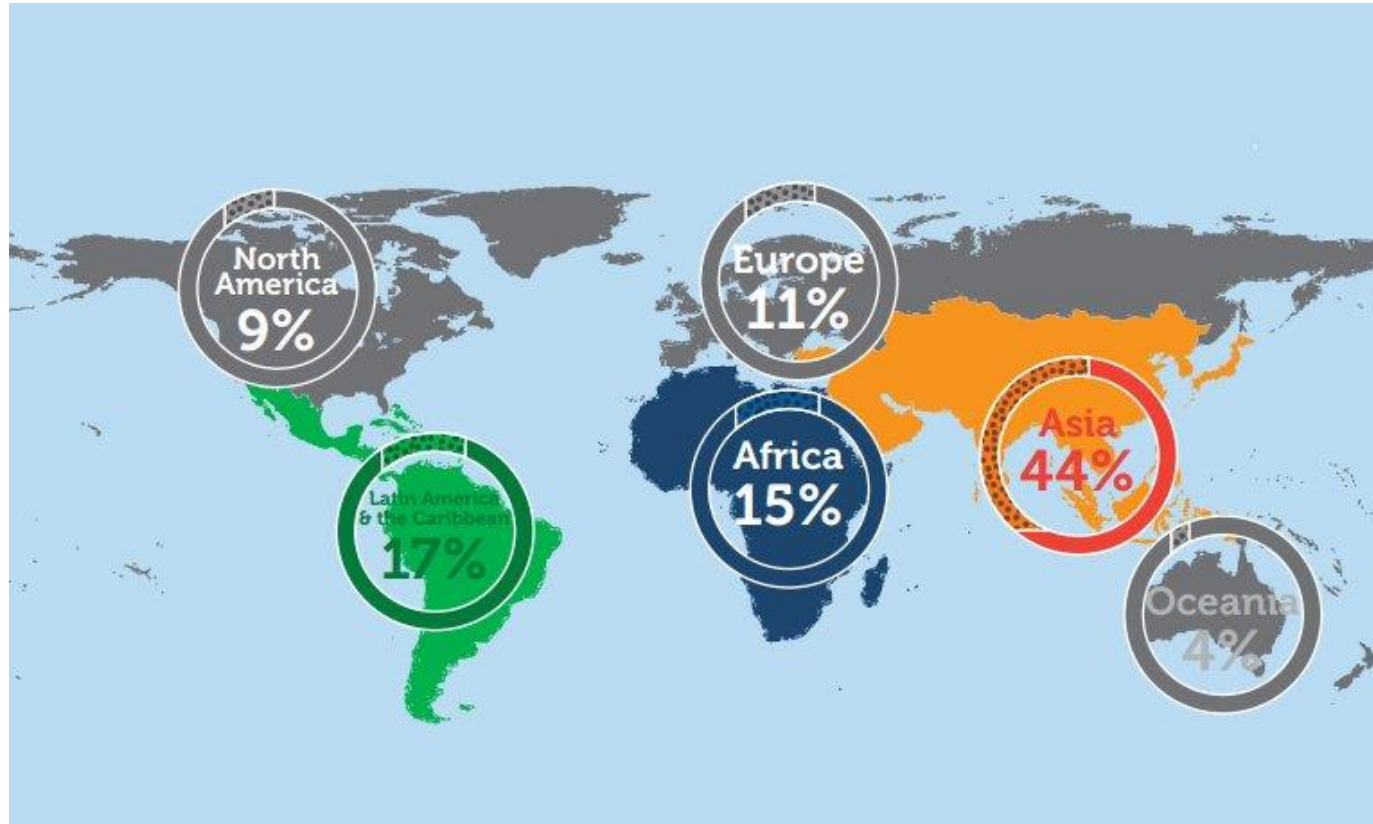


combustion
des savanes

En ce qui concerne l'élevage, les émissions issues de la fermentation entérique et du fumier ont représenté près des deux tiers du total.

Les chiffres sont des valeurs moyennes pour la période 2005-2014.

GHG EMISSIONS FROM AGRICULTURE



Africa:

- 17% of the global population
- **4% of total GHG emissions**

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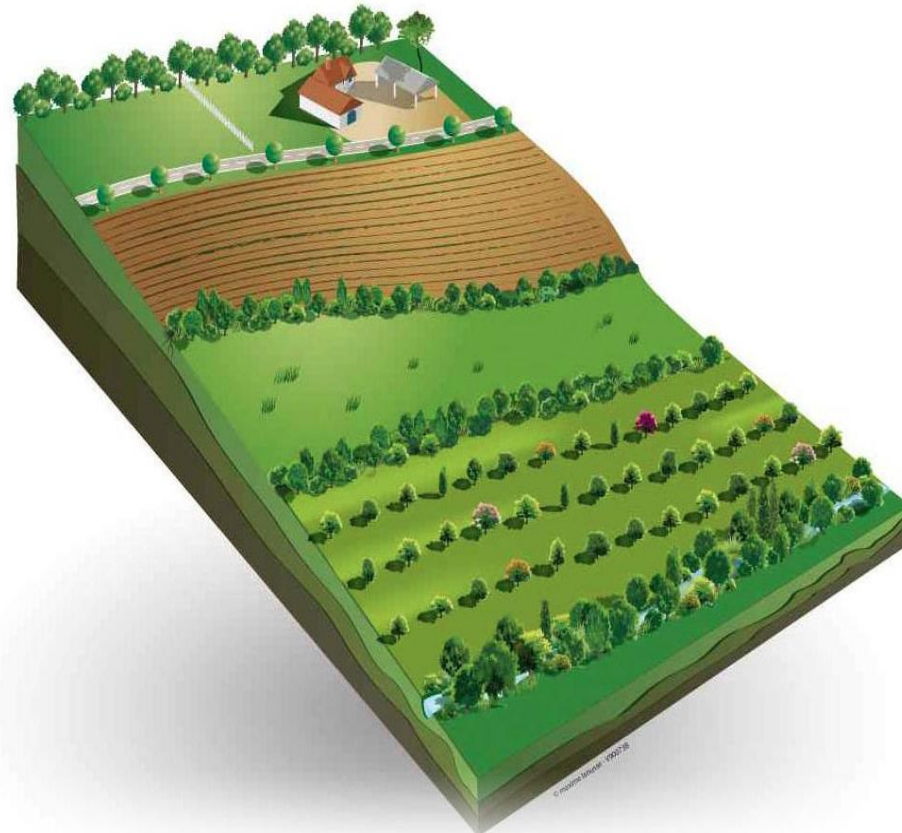
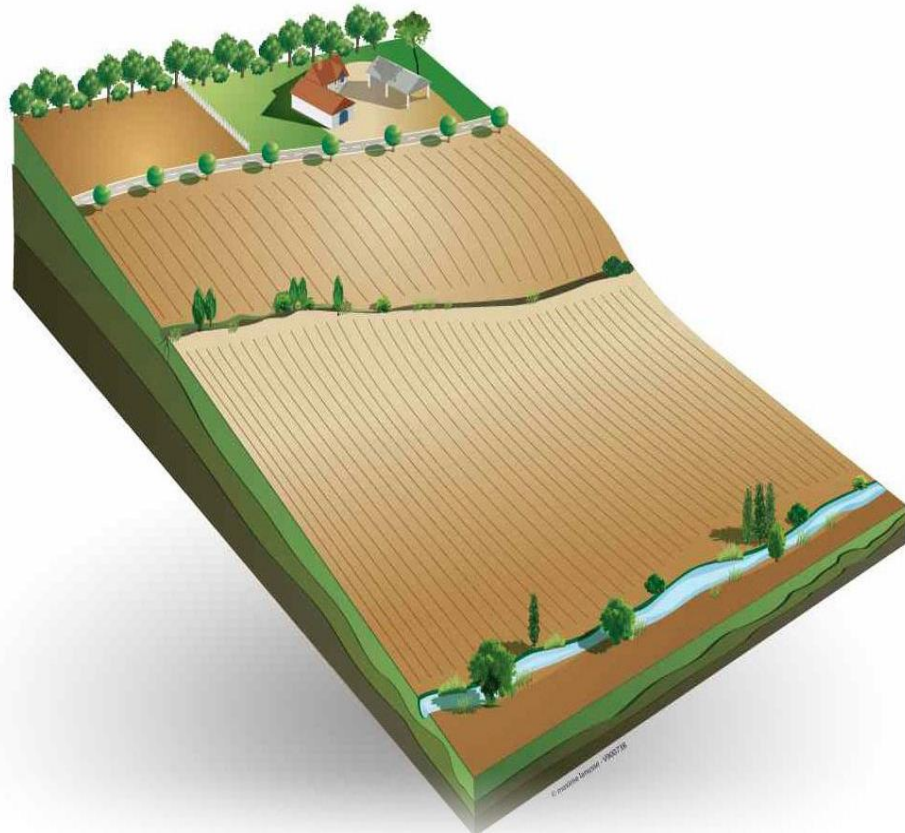
EROSION AND LEACHING



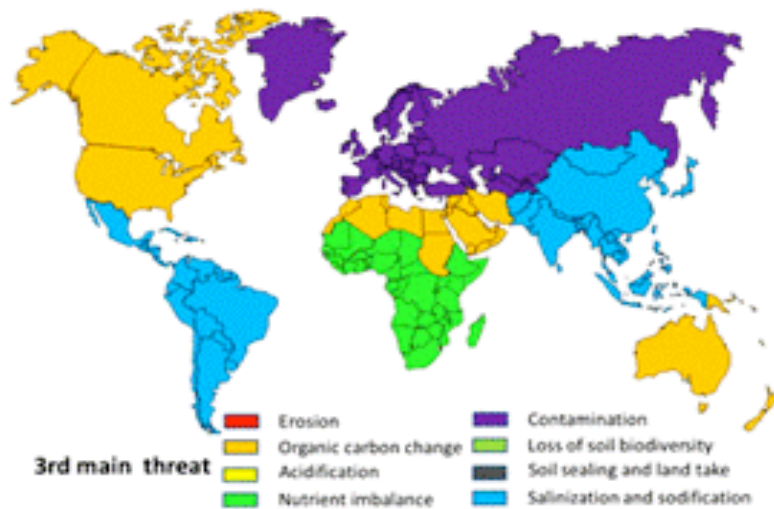
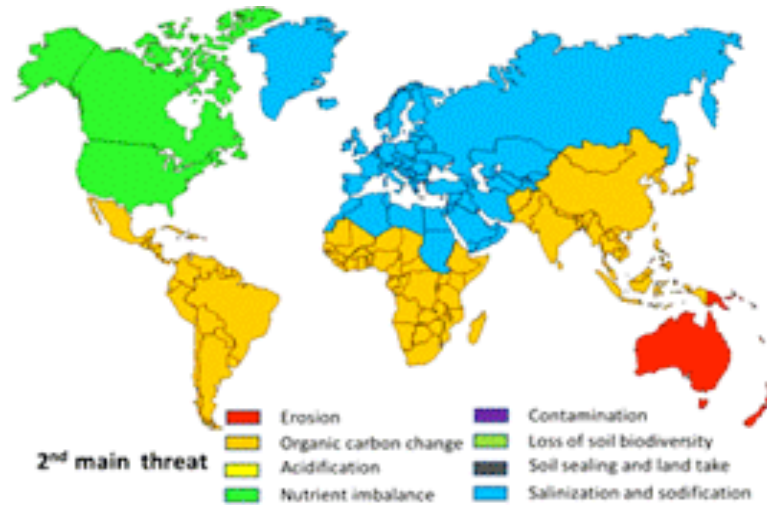
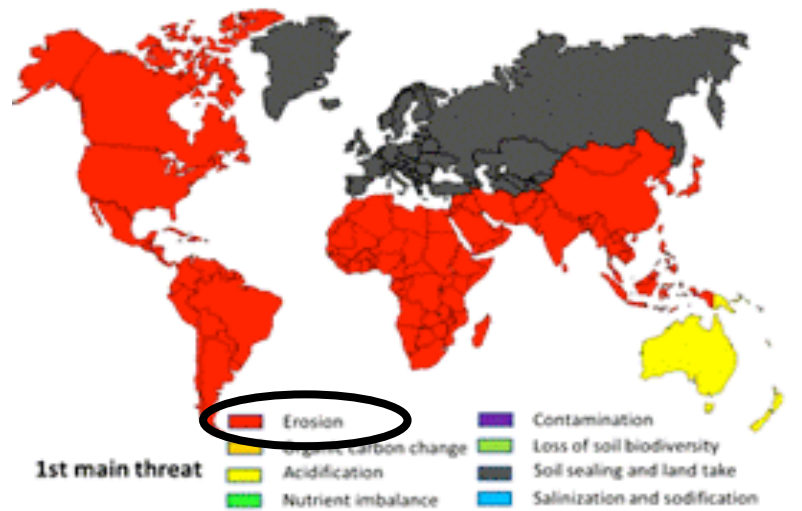
EROSION AND LEACHING



EROSION AND LEACHING



IS THIS A PROBLEM FOR AFRICA?



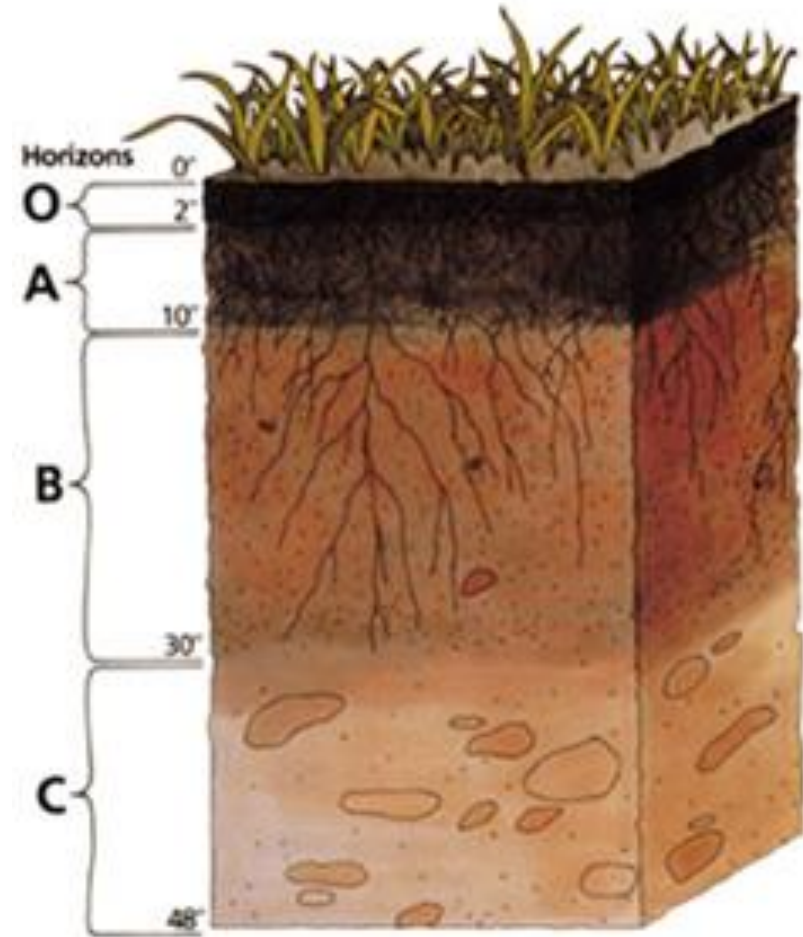
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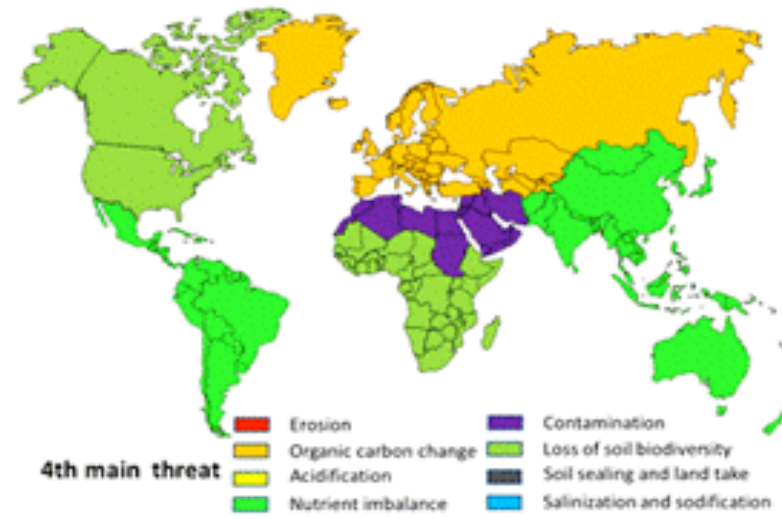
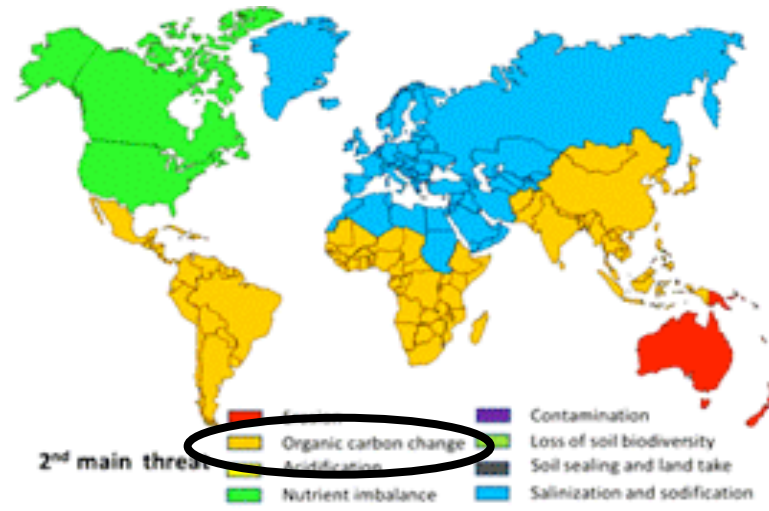
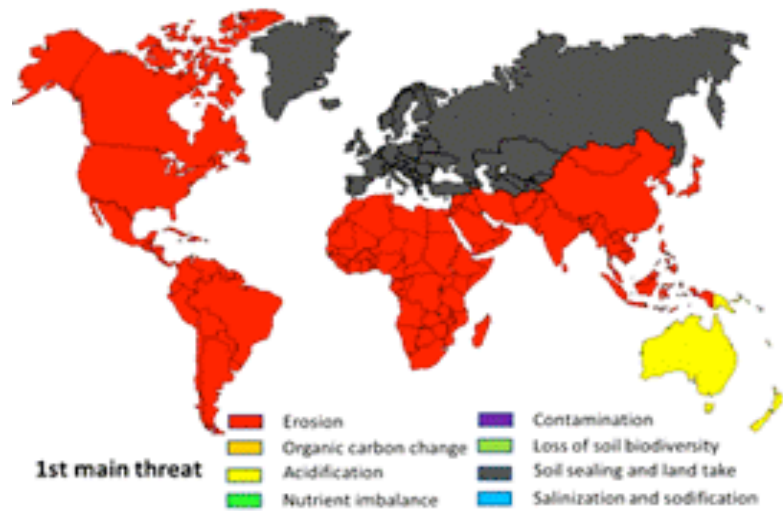
SOIL DEGRADATION - LOSS OF ORGANIC MATTER

Loss of organic matter:

- Warm, humid climate
- Exposed and open soil
- Absence of organic inputs (compost, manure, slurry etc.)



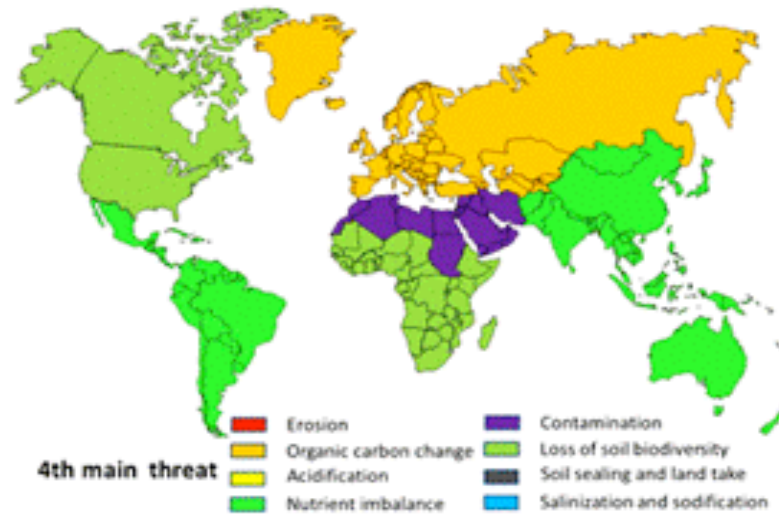
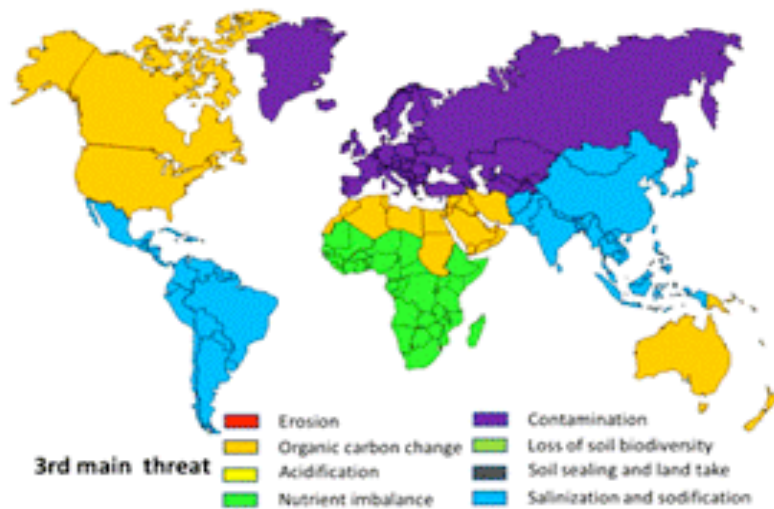
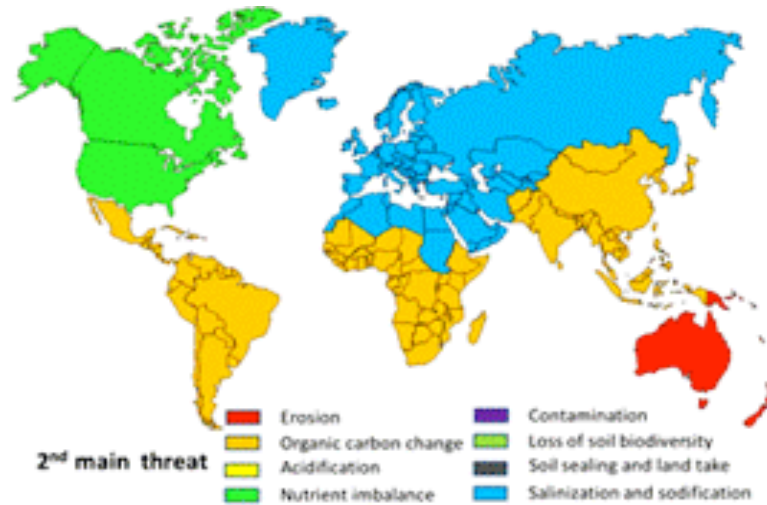
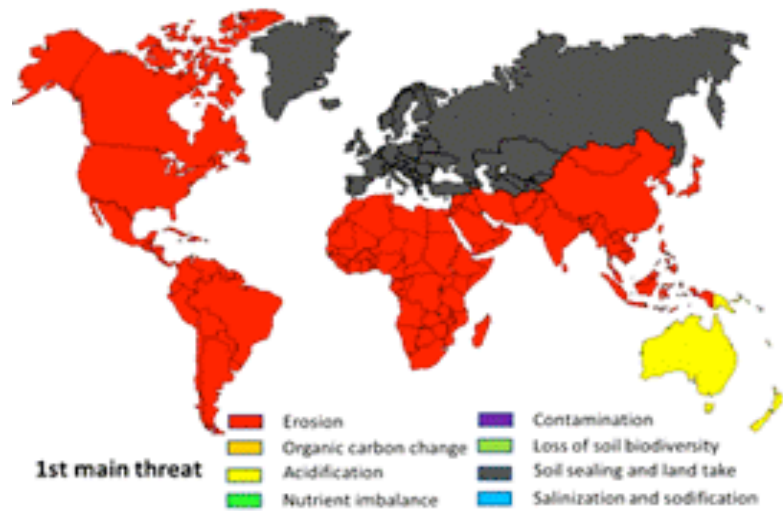
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SOIL DEGRADATION – OTHER PROBLEMS

- Acidification
- Compacting
- Salinisation

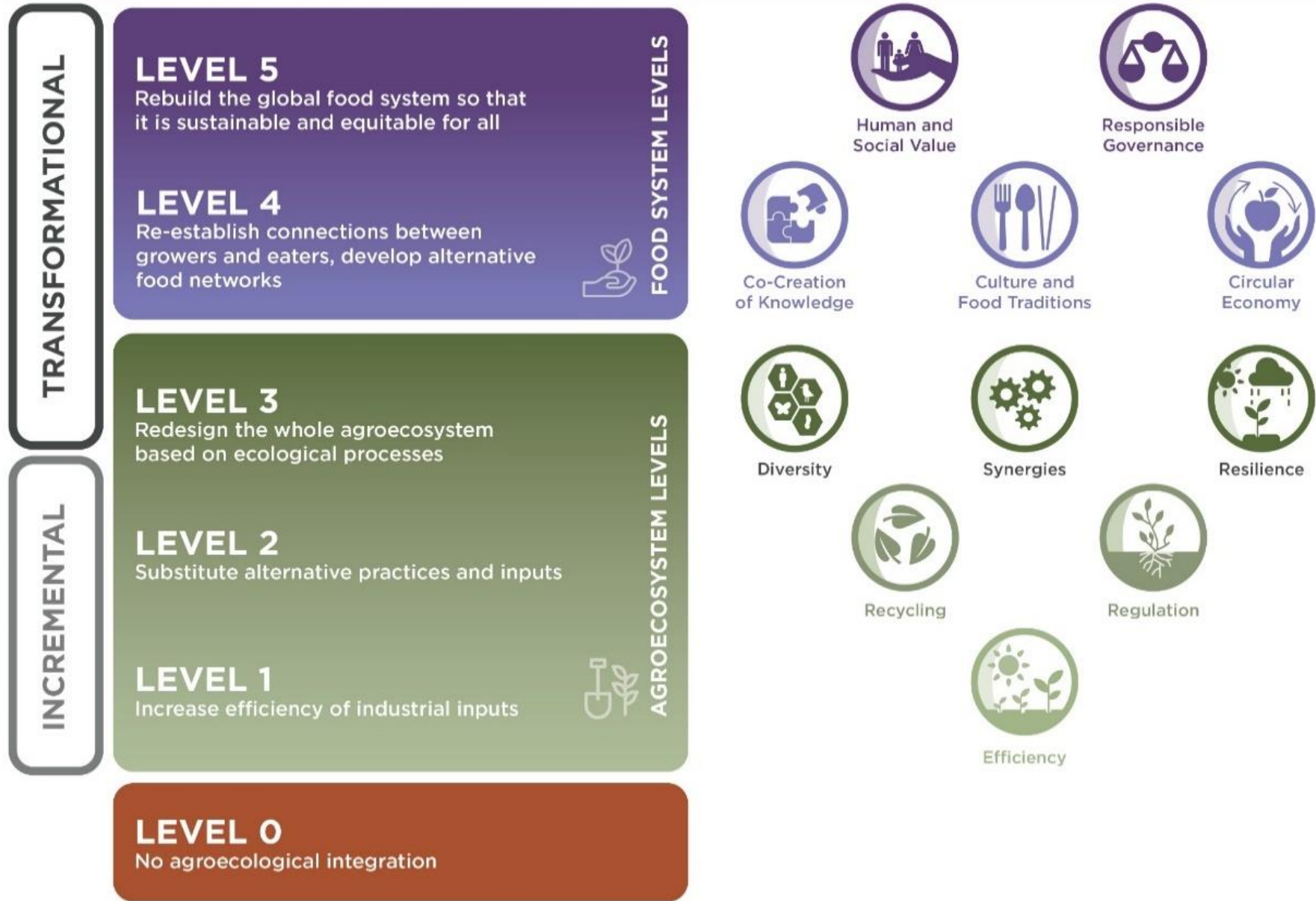
IS THIS A PROBLEM FOR AFRICA?



WHAT IS THE ALTERNATIVE? AGROECOLOGY?

- Agroecology can be defined as a scientific field, an agricultural practice and a social movement.
- It is an innovative, holistic approach to the sustainable and rational use of agricultural and water resources.
- This course will discuss agroecology as a science and agricultural practice only.
- It allows the production of healthy and high nutritional quality foodstuffs, free of residues of products derived from synthetic chemistry.
- The approach aims to produce, regenerate soils and degraded environments as well as promote biodiversity.

5 LEVELS OF FOOD SYSTEM CHANGE AND 10+ ELEMENTS OF AGROECOLOGY



AGROECOLOGY - IN CONCRETE TERMS



Polyculture élevage



Rotations culturales



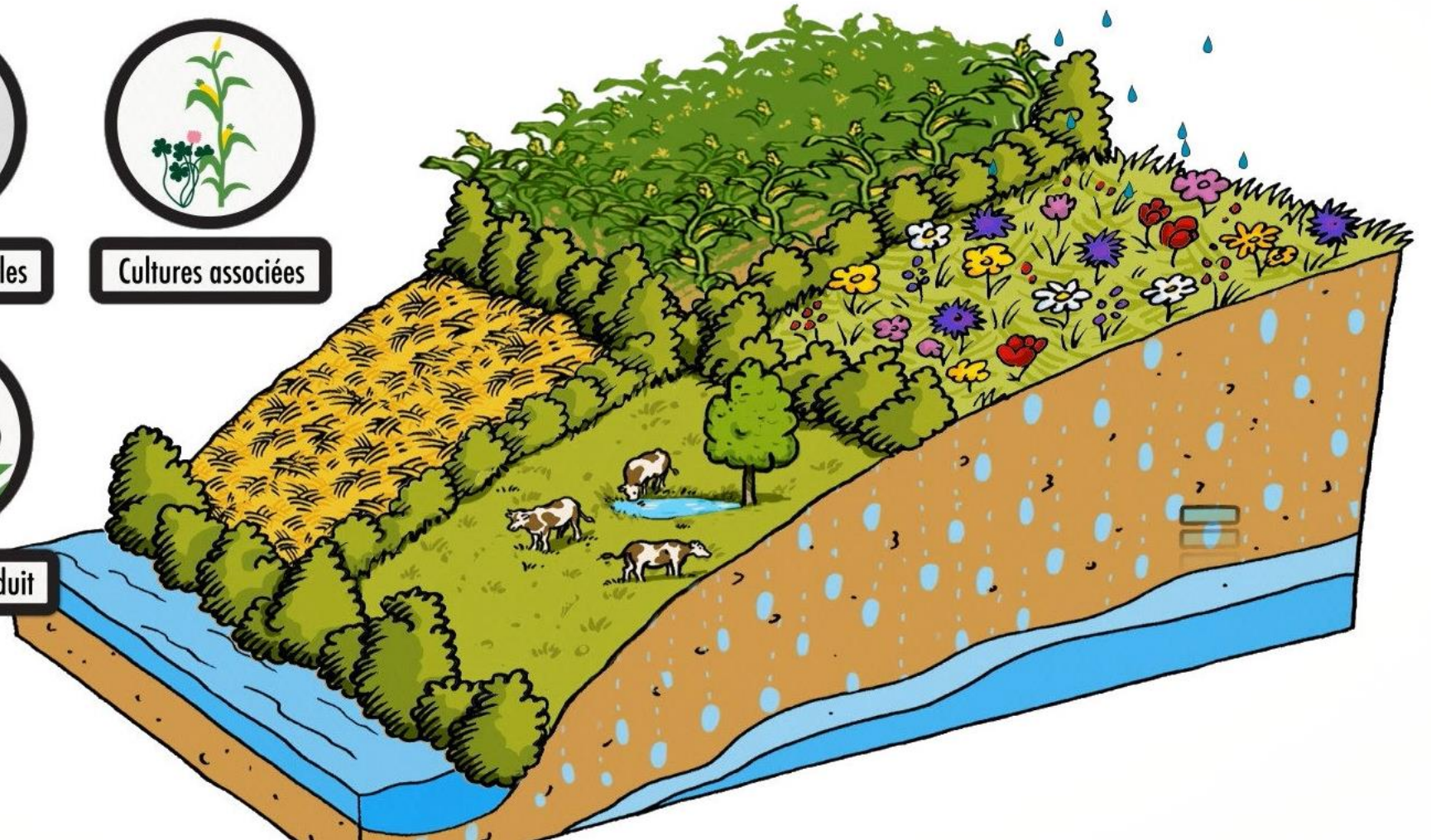
Cultures associées



Irrigation économe



Travail du sol réduit









AGROECOLOGY - INTRODUCTION

High potential for small-scale food production:

- Cost reduction (pesticides, seeds, fertilizers)
- Income diversification
- Preservation of the soil
- Better resilience to climate hazards in a context of global disruption
- Impact on health

Constraints:

- Complexity of production systems
- Difficulty in marketing a very varied offer
- High labor force required
- Yields sometimes lower than in conventional farming
- Difficulty in managing pests on certain crops (especially vegetables)

AGROECOLOGY - INTRODUCTION

Agroecology is therefore particularly suitable for small-scale food production:

- Small area
- Abundant labor force
- Crop diversity beneficial to farmers

Agroecology has the potential to improve the standard of living of these farmers, especially those in difficulty (infertile soils, irregular or insufficient water resources, few resources).

Production diversity is less amenable to cash crop farming, where farmers are often specialized in a particular crop.

AGROECOLOGY COURSE - OBJECTIVES

- This course is intended for agronomist students with good background in soil sciences and conventional agriculture.
- This course covers some of the basics of ecology, chemistry and agronomy needed to understand agroecological practices.
- It describes agroecological practices and why they are used.

AGROECOLOGY COURSE - OBJECTIVES

The aspects dealt with are the following:

- Soil fertility management
- Pest and disease management
 - Biodiversity
 - Rotations
 - Crop associations
 - Natural treatments
- Animals in the agroecological system

AGROECOLOGY COURSE - OBJECTIVES

- After this course, the student will be able to understand the functioning, advantages and disadvantages of an agroecological production system, as well as identify the differences with conventional systems.
- The course alternates prerecorder presentations with field trips at Eladale Farm.

Homework (weekly):

1. Read chapter in handout before class (30-60 min)
2. Do the exercises after class (30-60 min)

PROGRAM

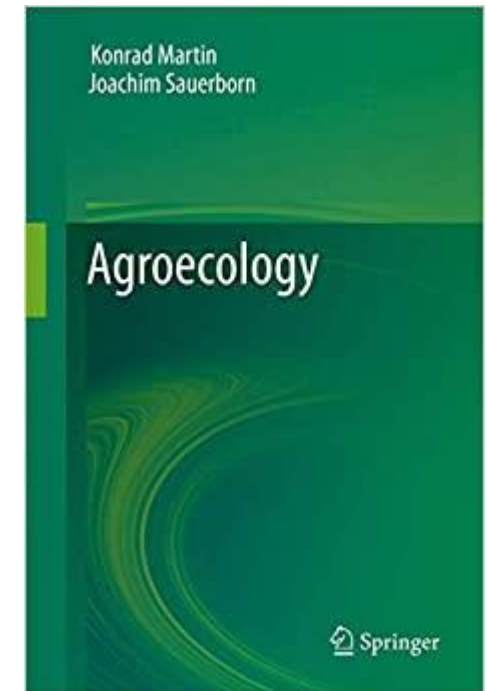
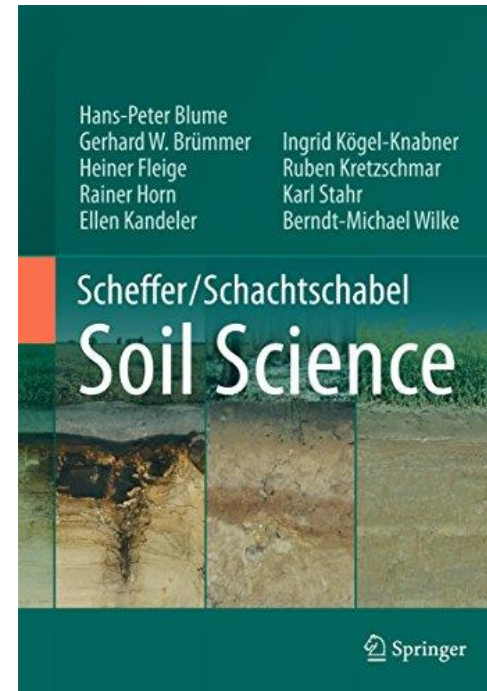
Week	Day	Part 1	Part 2	Part 3	Teacher	To read (Script)	Exercise
22.mai	Free	Ch. 1 Introduction	Ch. 2 Pest and Disease Management	Ch. 3 Crop association (General)	Kim	Chapter 1, 6 and 7	
29.mai	Free	Ch. 4 Soil Protection	Ch. 5 Water retention techniques and erosion protection		Kim	Chapter 3 and 5, Optional Chapter 2	Rotation Planing
05.juin	Monday morning, Wednesday morning, Friday morning	Field trip to eladale : water retention technique and soil protection (zai, half-moon, hugelbeets, stone barrier, hedges)	Field trip to eladale : crop association, semi-agroforestry, biodiversity and disease management	Feedback and discussions on crop rotation exercise	Kim, Abebe, Obsuman		Practical exercices on farm: doing zai, half moon, hugelbeets // planting associated crops // preparing cocktail insect repellent
12.juin	Free	Ch. 6 Crop association (Specific)	Ch. 7 Semi-Agroforestry and Agroforestry	Ch. 8 Seed Collection	Kim	Chapter 7 and 9	Rotation Planing (with associations)
19.juin?		Ch. 9 Agroecology and Climate Change	Ch. 10 Fertilisation	Ch. 11 Animals in Agroecology	Abebe	Chapter 1, 4 and 8	
26.juin	Monday morning, Wednesday morning, Friday morning	Field trip to eladale: fertilisation, manure storage, green manure	Field trip to eladale : animals and pasture	Field trip to eladale : seed collection	Abebe, Obsuman	Chapter 4 and 8	Fertilisation Plan for rotation plan
03.juil	Free	Chapter 12 Designing an agroecological farm			Kim		
17.juil							Design an agroecological farm with rotation and fertilisation plan from before

AGROECOLOGY COURSE – LEARNING RESOURCES

- Script: Agroecology: A Science and Practice of Agriculture for Smallholder Farmers in Sub-Saharan Africa
- Course Slides available

Additional literature in English

- Soil Science (Scheffer/Schachtschabel)
- Agroecology (Martin/Sauerborn)



RÉFÉRENCES

- Abong'o, D. A., Wandiga, S. O., Jumba, I. O., & Kylin, H. (2014). Impacts of pesticides on human health and environment in the River Nyando catchment, Kenya.
- Abhilash, P., & Singh, N. (2009). Pesticide use and application: an Indian scenario. *Journal of hazardous materials*, 165(1-3), 1-12.
- FAO (2016), ÉMISSIONS DE GAZ À EFFET DE SERRE issues de l'agriculture, de la foresterie et des autres affectations des terres
- Montanarella, L., Pennock, D. J., McKenzie, N., Badraoui, M., Chude, V., Baptista, I., . . . Yagi, K. (2016). World's soils are under threat. *Soil*, 2(1), 79-82.

QUESTIONS?

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