What about soil?
Principles to build healthy soils

Presented by Vira Leng and Florent TIVET

Training on Seed production and Saving, Integrated Pest Management and Soil health

August 6th, 2018, Bos Khnor Station, Chamcarleu, Kampong Cham

Soil, the foundation of agrarian societies

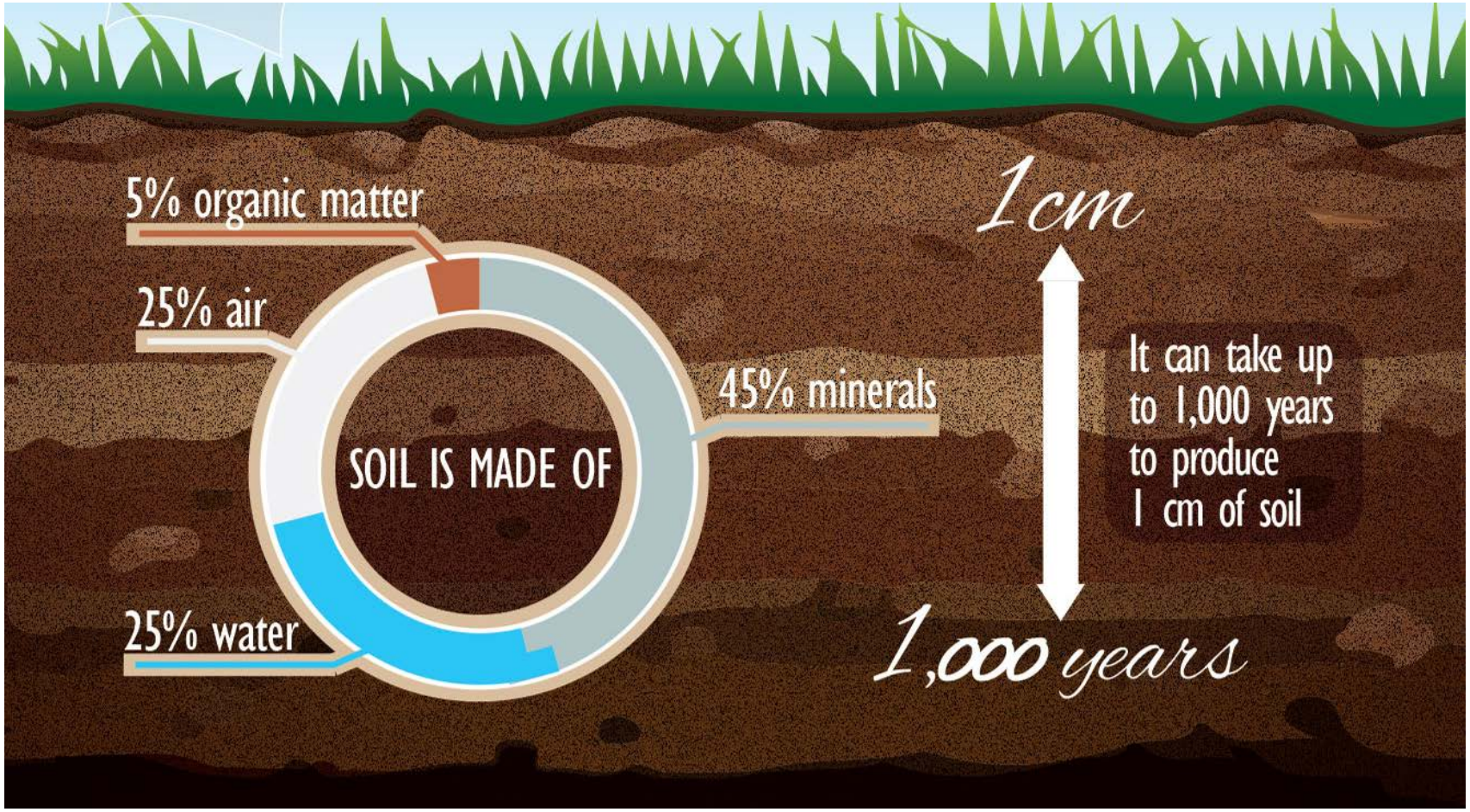
Soil is the basis for:

- Food
- Feed, fiber, latex
- Fuel
- Medicinal plants
- Ecosystem services

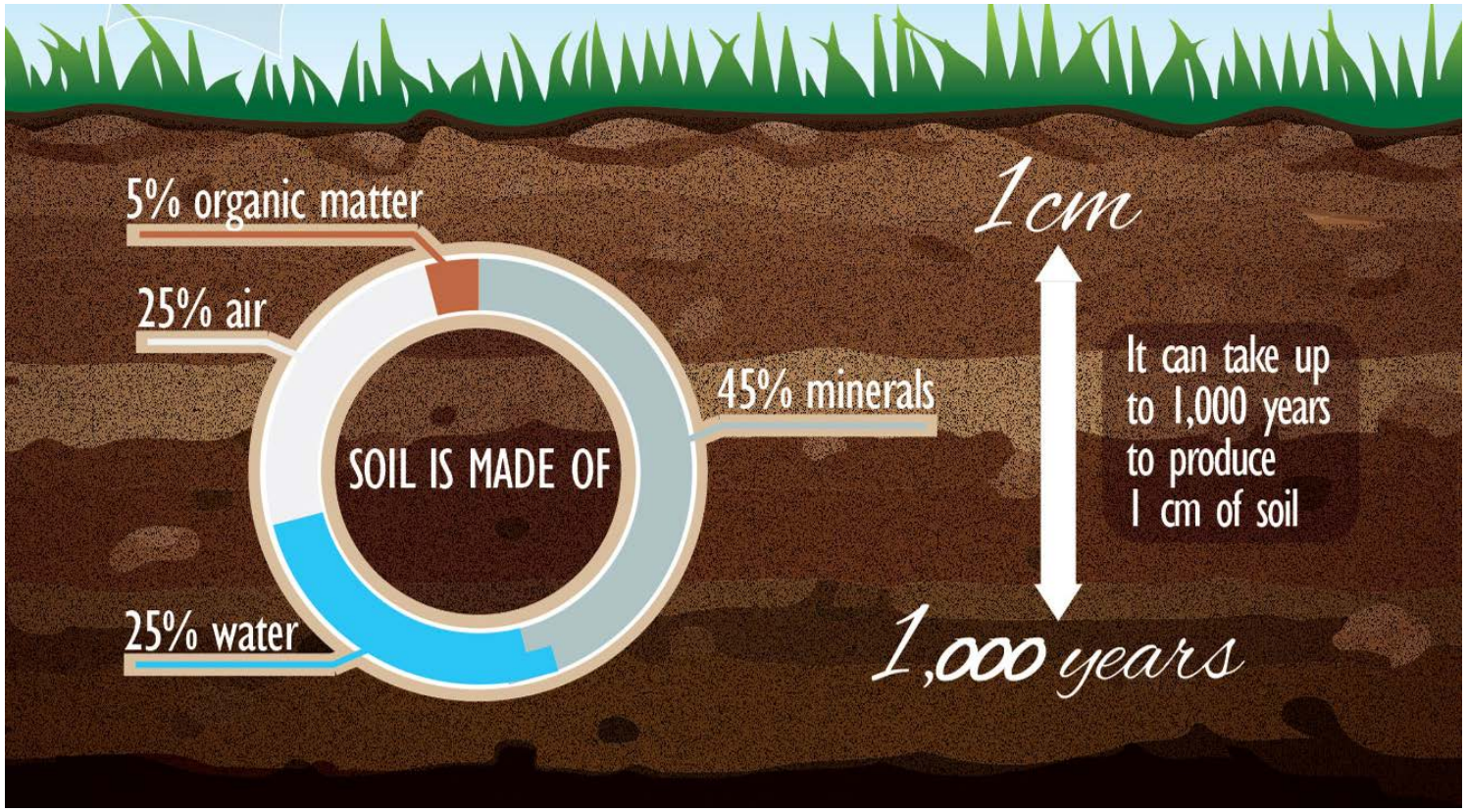
A diversity of parent materials, climate and topography

Soil: a complex integrated living system

- Do you know what a soil is made for ?



Soil: a complex integrated living system

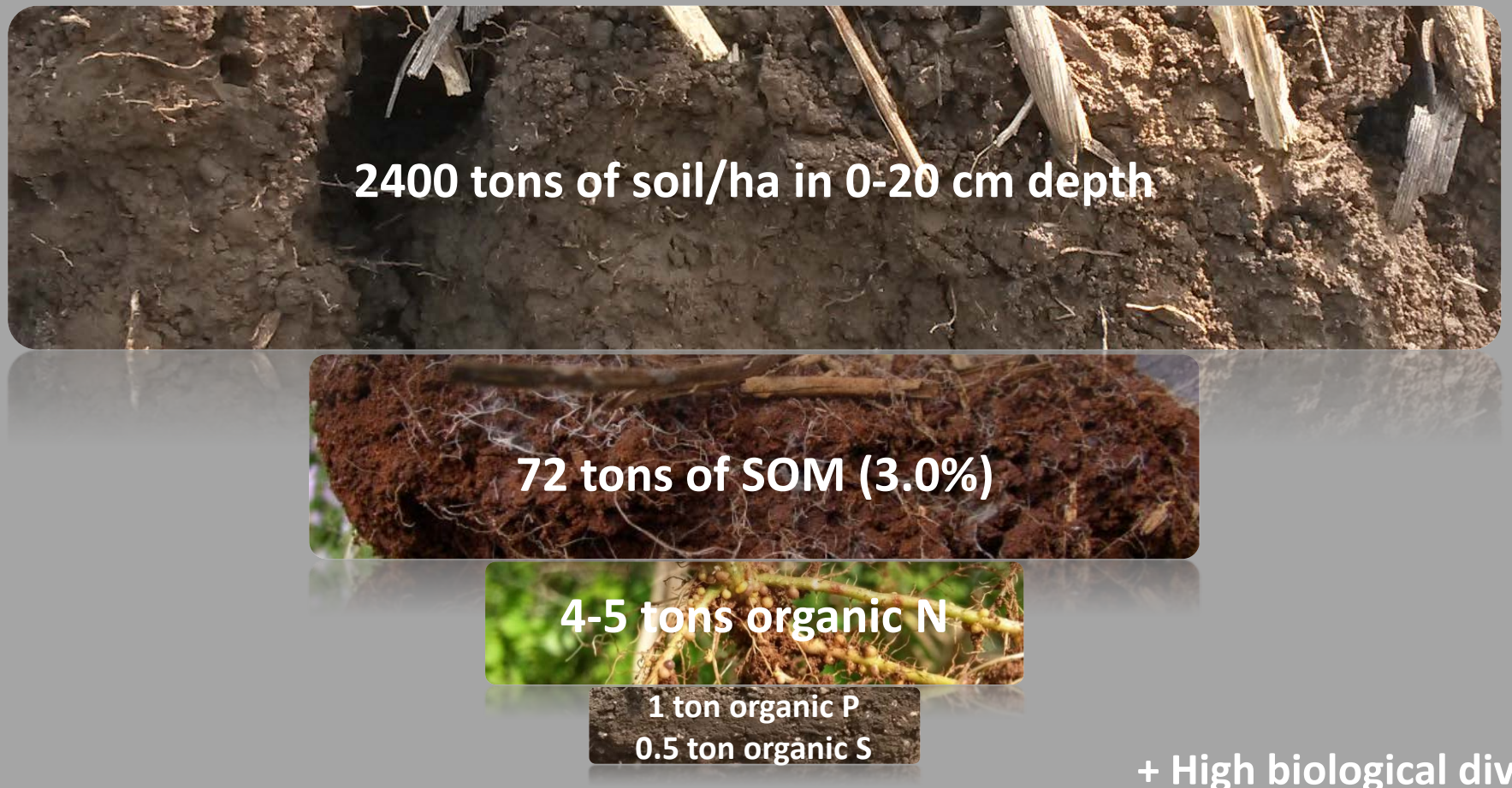


- Large amounts of nutrients under an organic form, they don't leach.
- This is not the same value than mineral fertilizers.

- Soil organic matter can be responsible for more than 80% of the cation exchange capacity (CEC: Ca, Mg, K…) of highly weathered soils, such as Oxisols and Ultisols.

Soil, a complex integrated living system

Red Oxisol

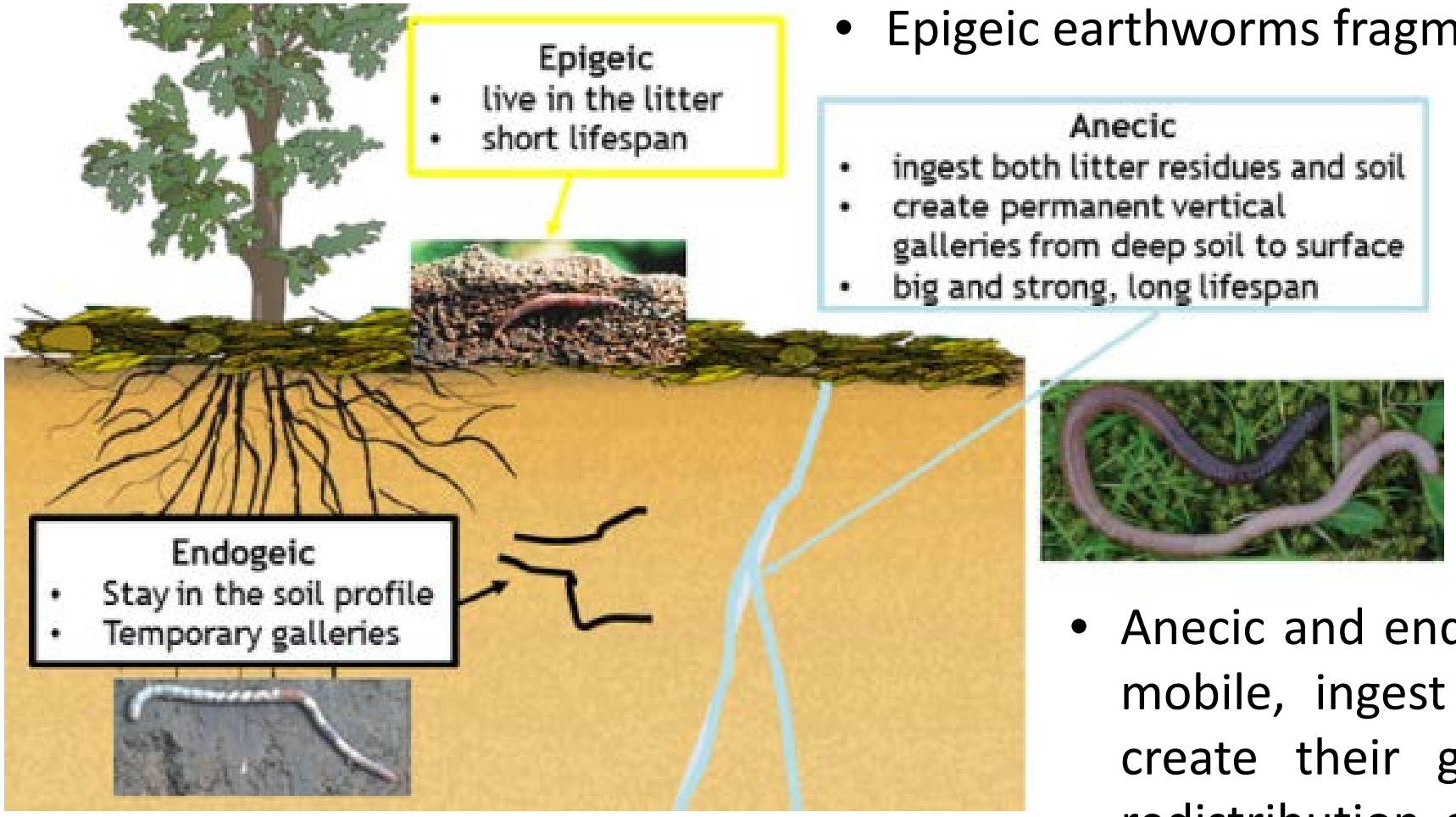


SOM = C, H, O, N, P, S

1 ton microbial-C

+ High biological diversity
Macrofauna (earthworm, ants …)
to microbial communities (fungi, bacteria)

Role of earthworms



- Epigeic earthworms fragment the litter

- Anecic and endogeic earthworms are very mobile, ingest high quantities of soil to create their galleries and organize the redistribution of litter to deeper horizons of soil. **They connect the organic and the mineral worlds!**

Sandy podzolic, Stung Chinit, Kampong Thom (80%)

Flood plains, Banan, Battambang (50% clay)

Red Oxisol, Upland, Chamcarleu (60% clay)

Mollisol, Rattanak Mondoul, Battambang (50% clay)

Soil: a complex integrated living system

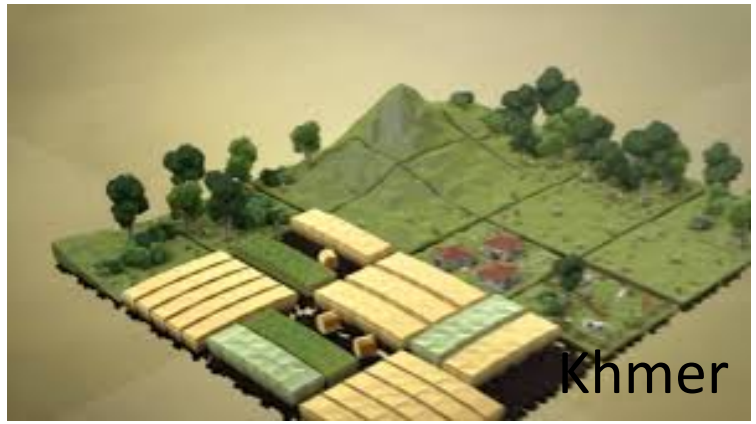
- Which indicator are you using to classify the soil?
- Do you use vegetation and weeds as indicator of soil fertility?
- Which weeds are representative of healthy soils and by contrast which ones are related to unfertile soils ?


Limited top soil that can be washed away in
few years by inappropriate practices

Global
Soil Week

Soil. The Substance
of Transformation.

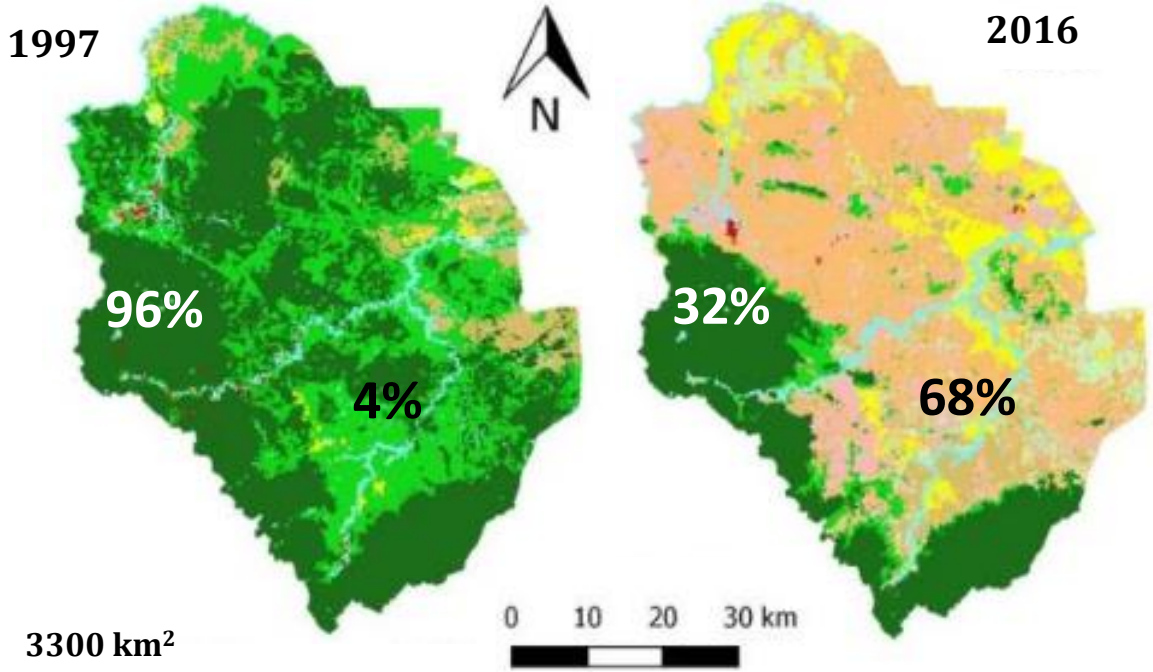
Let’s talk about soil



Agrarian transition – Uplands of Battambang

Soil restoration: the engine of economic development, transforming rural communities

-200,000 ha of forest in 20 years in NW Cambodia



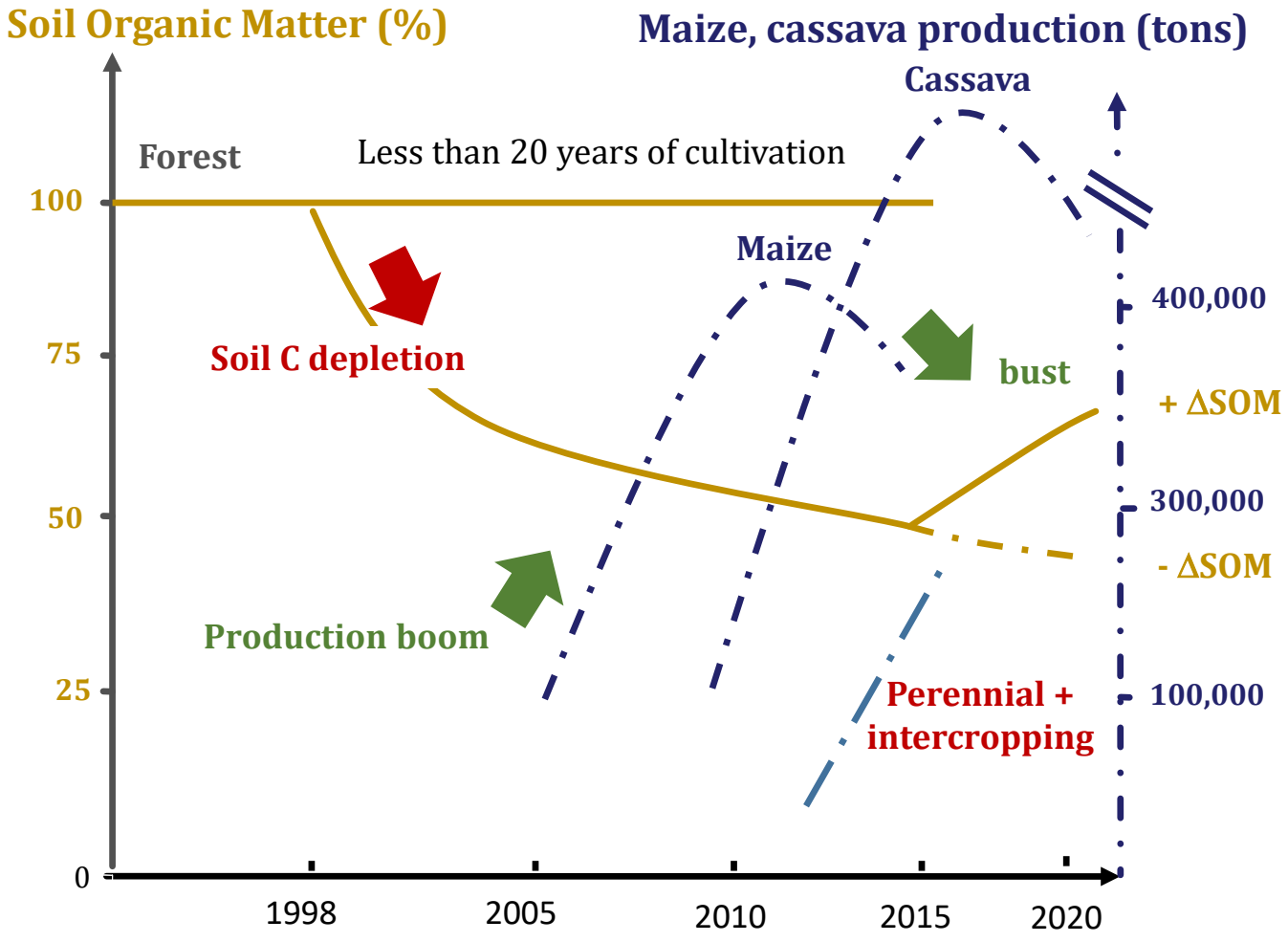
3300 km²
Pailin + 2 districts of Battambang (Rattanak Mondoul, Samlout)

Land rehabilitation is extremely important for maintaining the possibilities for vulnerable communities to earn a livelihood from natural resources management.

Kong et al., 2018. Applied Geography

- Positive economic impacts but not for all and not on the long run (decreasing profitability of most of the farming systems)
- Negative environmental impacts (biodiversity, watershed management)
- Livelihoods improvement at the beginning but increasing social differentiation

Challenges: Invest in Soil Organic Matter



Key elements to maintain and enhance soil fertility

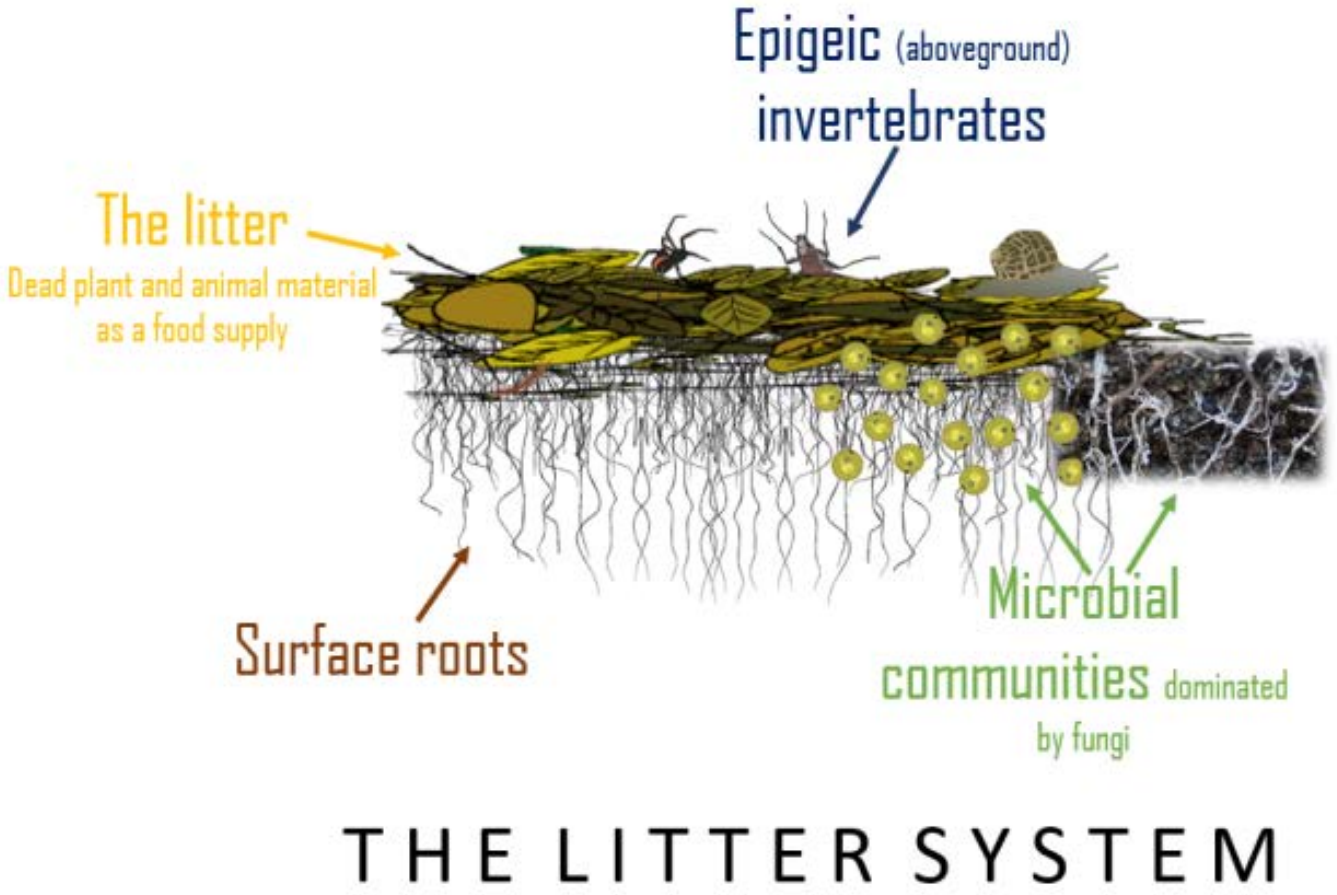
Use of organic materials for soil fertility management

- Who is using organic materials and from what?
- For what kind of crops do you use organic materials?
- How many times do you apply organic materials per year ?
- For the others do you use mineral fertilizers ?
- Why using mineral fertilizers (available, easy to use, no organic materials around house/village, efficient …)?
- How plant materials are used after harvest (mulch, burn, plough to decompose, fodder, composting, firewood …) ?
- Are there organic plants materials in your village that are underutilized ?

Sustain healthy soils and agroecosystems

Different elements should be combined (minimize soil disturbance, permanent soil protection, diversified cropping system) …

The litter system



The litter is the belt connecting ecological processes between soil and plants.

A permanent litter, hosting together fragmenting organisms, the soil microflora and humus **is one of the pillars of productivity**.

The litter protects the underlying soil, regulating temperature and moisture, fostering other biological activities.

Sustain healthy soils and agroecosystems

… plant and cropping systems diversity are the engine that drives soil-crop interactions and enhances ecosystem services.

Examples of cover crops – Need for genetic materials and seeds!

Plant diversity, our main tool to build a healthy and living soil (55 sp., 335 cv.)

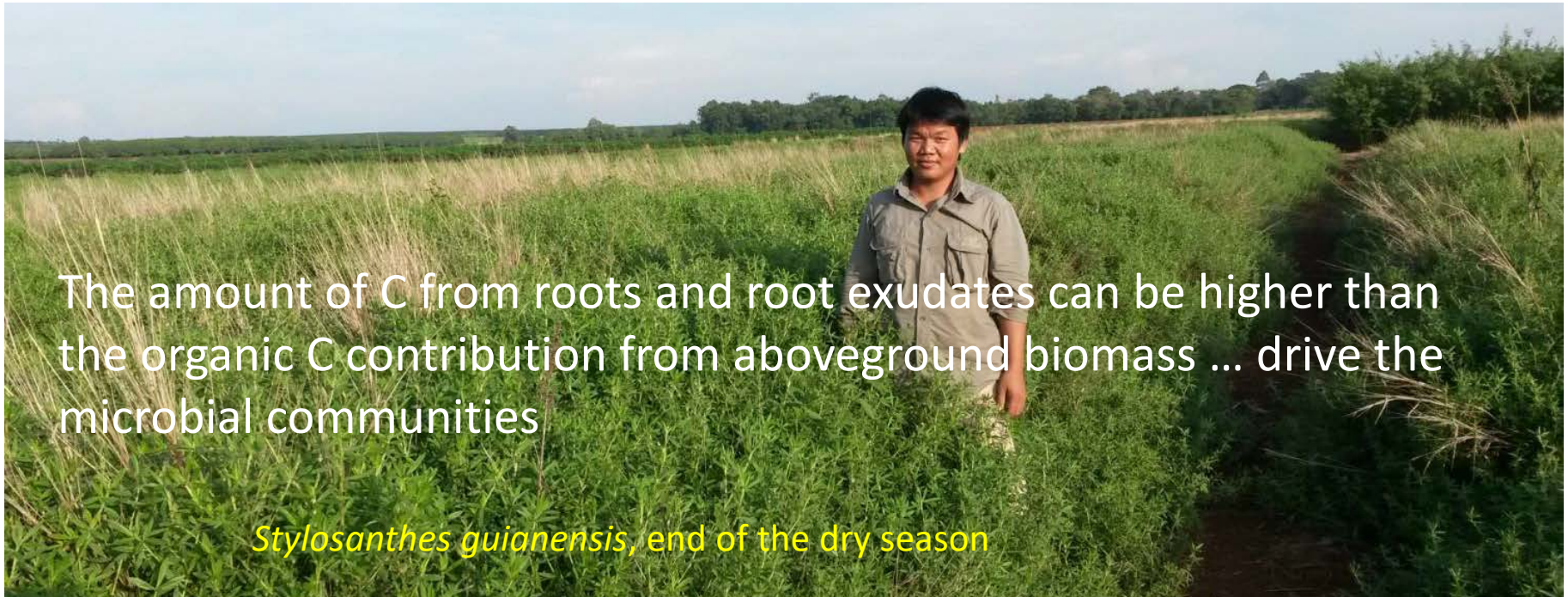
- Increasing soil organic C and nutrient cycling
- Increasing soil biota
- Improving soil structure and aggregation
- Increasing water infiltration and retention
- Controlling weeds (shade, allelopathy)
- Fixing atm. N_2
- Managing pests and diseases through bioregulations
- Diversifying resources (grains, fodder, fiber)

Cover crops, some key species

From S. Boulakia

Rotation also concerns roots!

We need living roots even during the dry season



The amount of C from roots and root exudates can be higher than the organic C contribution from aboveground biomass … drive the microbial communities

Stylosanthes guianensis, end of the dry season

Nutrients into an organic form

Replace fertilizers through N fixing
(plants and microbial)

Nutrients into an organic form they don’t leach!

A range of cropping systems under DMC management - Cambodia

Rice

Soybean

Cassava

Maize, sowing on green cover crops

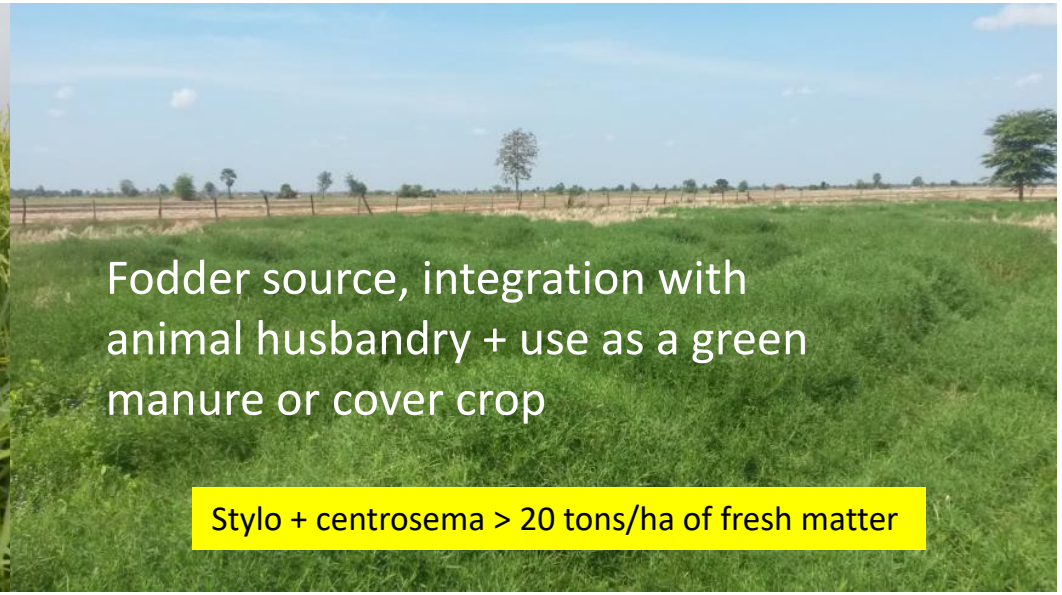
CA and Appropriate-scale machinery

Consortium RUA/FAE/CESAIN, GDA/DAEng/DALRM, University of Illinois Urbana – Champaign, Kansas State University, CIRAD (USAID funding, Feed the Future, SIIL)

Broadcasting cover crops on soybean

NT planter, roller crimper, seed broadcaster …

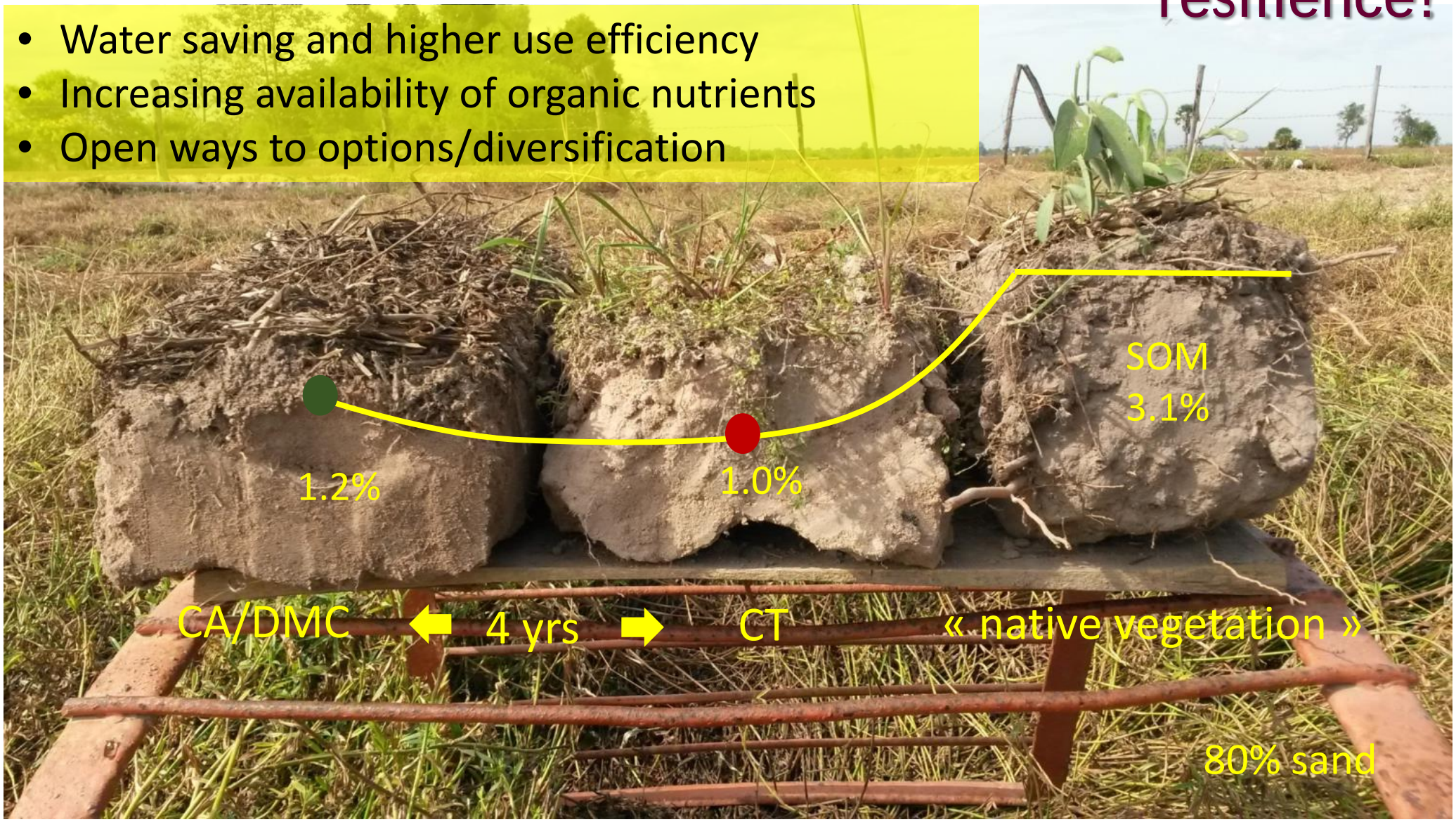
Rain-fed lowland (80% sand): diversification and soil fertility management



Stung Chinit, April 2018

We have to reinvest into soil fertility to build resilience!

- Water saving and higher use efficiency
- Increasing availability of organic nutrients
- Open ways to options/diversification



Hydromorphic plains: establishment of cover/relay crops after wet season rice (Battambang, Banan, 32 ha, 18hh)

Phka Rumdoul

- 2015: 3.5 t/ha
- 2016: 4.0 t/ha
- 2017: 4.6 t/ha

Banan district, hydromorphic plains, 1 wet season rice

Stylosanthes guianensis

Which value ($/ton) and for which area around the Tonle Sap?

May 2016

For annual upland crops: maize, cassava…

Farmer network, 2017: 265 ha, 94hhs
Service: $40/ha for NT sowing
$490/ha net profit for maize; +200$/ha when compared with CT


Think about seed production and sharing: example of sunnhemp, on-farm seed production, Rattanak Mondoul

Impacts of practices on Soil Organic Matter

Mollisol, Upland of Battambang, Rattanak Mondoul (0-10 cm)

	DMC	CT
Soil organic matter (%)	5.9 (+51%)	3.9
Total soil N (%)	0.48 (+60%)	0.30
Water infiltration (ml/mn)	143 (+90%)	75

Cassava under CA management and diversified cropping systems

Early CA maize

CA Cassava

Bos Khnor Station
Field visit on April 20th

Cassava under CA management and diversified cropping systems

- Offsetting the scarcity of labor force
- Improving cropping efficiency
- Minimizing soil disturbance

To know more – Youtube Channel CASC id

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CASC Id

1,779 subscribers

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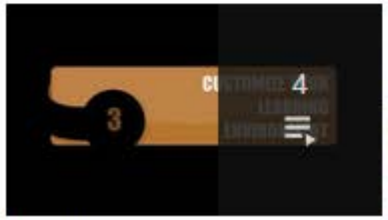

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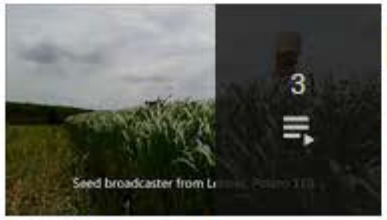

Appropriate scale machinery

Cover crops

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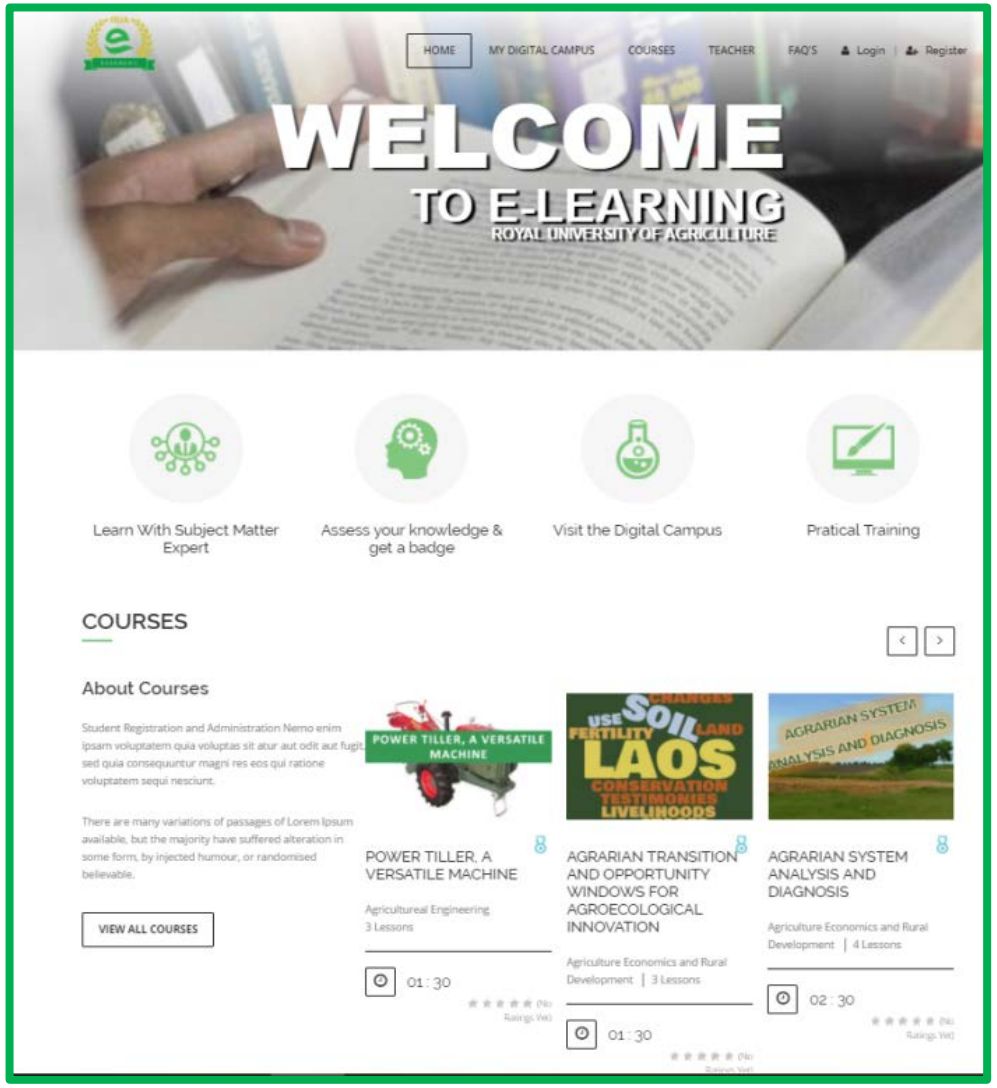
Crop cultivation under Cons...

To know more – E-Learning



- Building a healthy soil
- Introduction to Conservation Agriculture
- Soil organic matter
- Land use and land cover changes in NW Cambodia
- Agrarian transition and opportunity windows for Agroecological transition
- Agrarian system analysis and diagnosis

Partnership RUA, CIRAD, GDA/DALRM, SupAgro Montpellier and ITC


Same principles applied for mango, longan, rubber, banana