Rice farming under a sustainable intensification lens



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Outline

- Rice farming
- Principles of sustainable/ecological intensification
- A holistic approach considering all elements of the system
- Examples of innovative rice-based cropping systems

Issues/drivers

- Food security/livelihoods
- Transition (markets, policies, society, climate…)
- Sustainability/diversification

Rice farming

- Large diversity of rice farming systems.
- Water management/topographic position define the type of rice variety (photosensitive vs. non photosensitive).
- Intensive rice farming can provided high productivity gains under conditions of intensive resource use and a controlled and 'predictable' environment.
- But can be rapidly trapped into a constant need for maintenance and adjustments (i.e., agro-chemical inputs, plant genetic and mechanization) to environmental attributes that are becoming unstable, and changing at an accelerating rate.
- Concern on profitability, sustainability, environmental footprints, and food quality/safety.

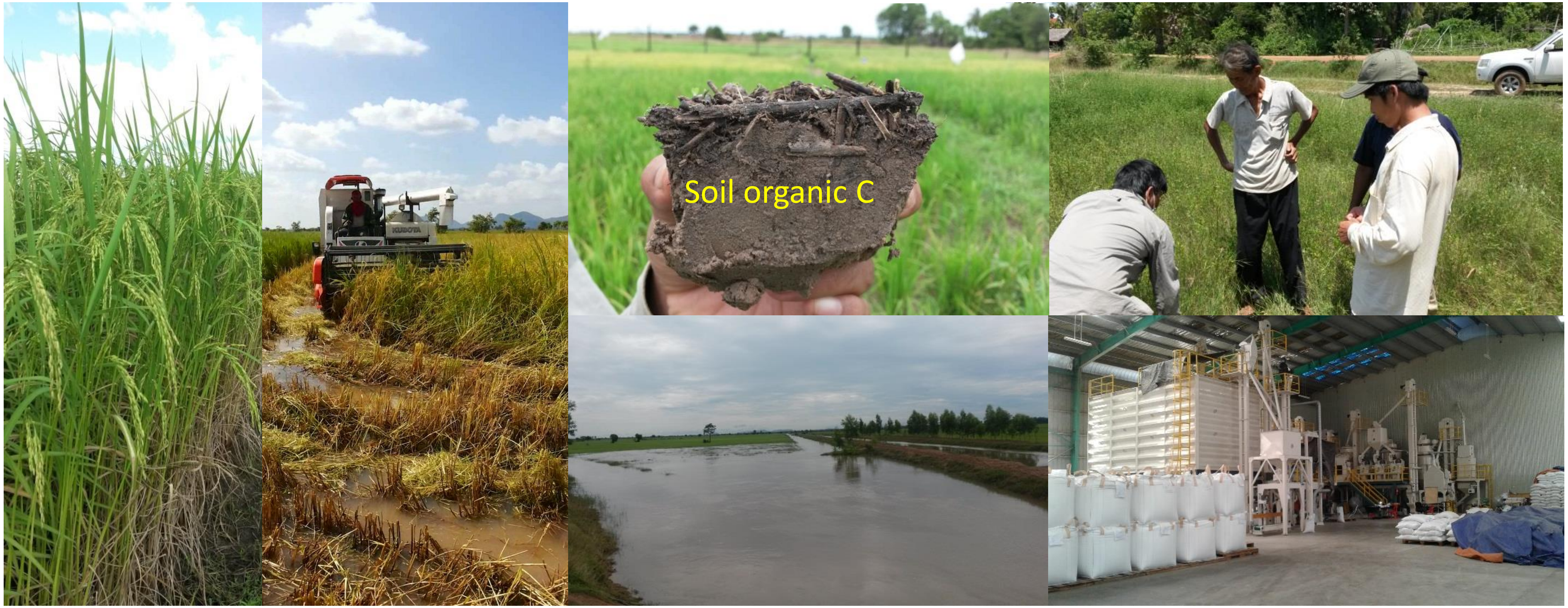
Rice farming

- Erratic rainfall and/or water management + intensification pattern → increase pressure of pests and diseases (sensitivity of certain rice cultivars to blast, Xanthomonas ...).
- Marked biophysical variation within the toposequence (from sandy to loamy-clay soils) within an irrigation scheme → soil fertility variability, rice yield, diversification, vulnerability.
- **Water is not an unalterable resource**.

Fast changes in agricultural machinery: laser-land levelling, plough/rotavator, combine harvester, planters, pumps …

- Emphasis on the management of water use and soil fertility preservation.
- Soil levelling is a prerequisite.
- Improving technology of rice seed broadcasting and the use of versatile no-till planter.

We need to invest into soil management



The tools
Genetic, fertilizer, machinery

The foundation
Soil and Water management

The connection
Collective learning, markets and policies

Sustainable/ecological intensification principles

- **Enhance the recycling of biomass** optimizing organic matter decomposition and nutrient cycling over time,
- **Minimize losses of energy, water, nutrients and genetic resources** by enhancing regeneration of soil, water resources and biodiversity,
- **Diversify cultivars/species and genetic resources** over time and space at the field and landscape level,
- **Enhance beneficial biological interactions and synergies** promoting key ecological processes and services.

Quality of products

Holistic approach, aggregating innovations at different scales

- Landscape design (trees, wind and pests barriers, forage sources …).
- Water, Soil and Plant management:
  - Conservation Agri., alternate wetting and drying, relay crops/green manure, rice straws management system …
  - Diversity of rice cultivars in the landscape (reducing the prevalence of pests and diseases)
  - Improved compost/rice husk/Ca-FMP, bio-control …




Plough-based + seed broadcast



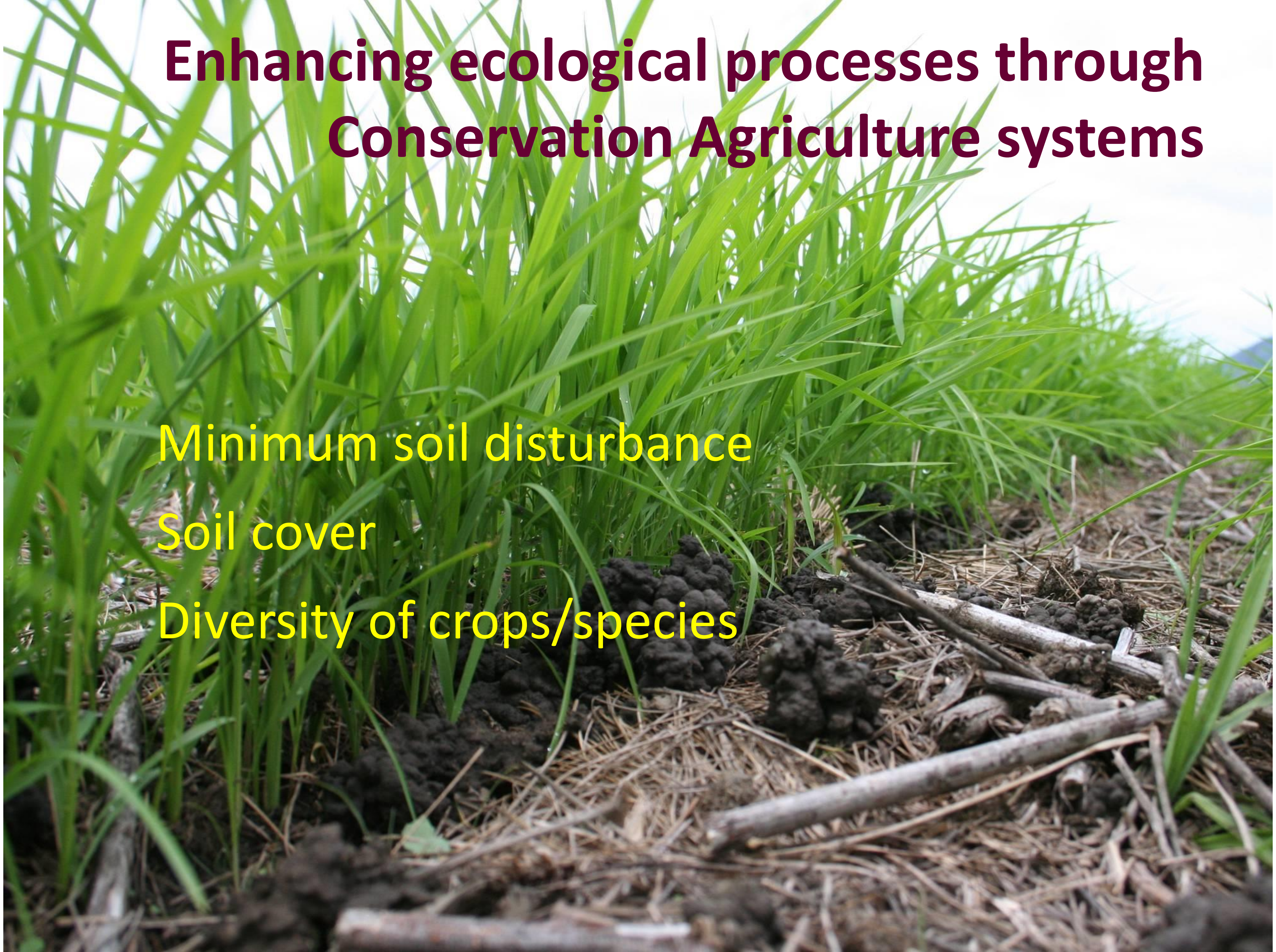
Plough-based + planter



CA cropping systems

Soil is protected and nourished


Enhancing ecological processes through Conservation Agriculture systems



Minimum soil disturbance

Soil cover

Diversity of crops/species

Irrigation scheme → Diversity of cropping systems/practices, rice and diversification

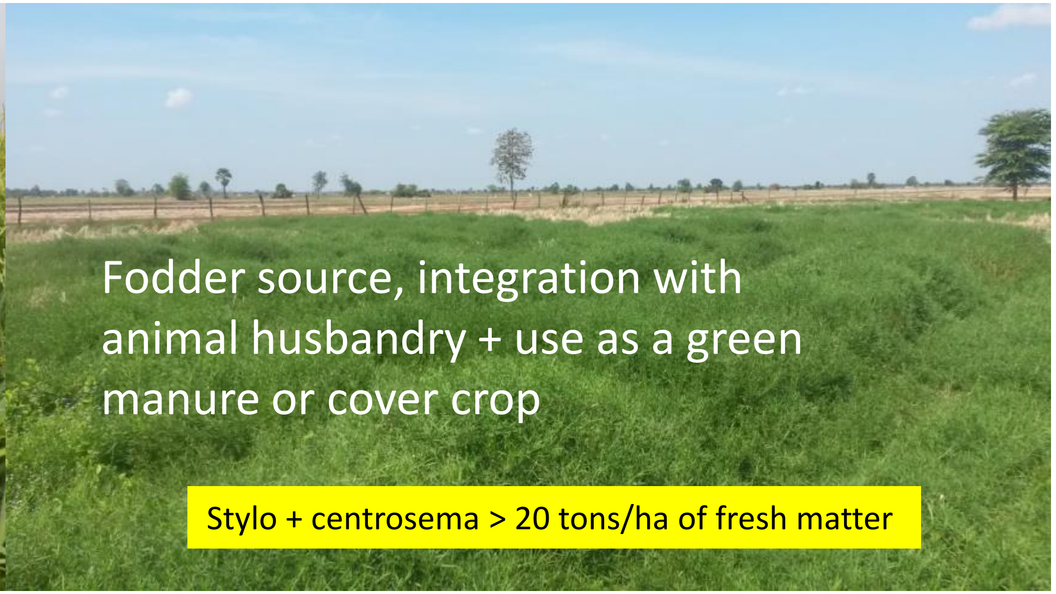
- Diversity of rice cropping systems within an irrigation scheme and in the flood plains:
  - 2 rice cycle (+ ratoon)+ cover/relay crops (fodder sources and/or grains),
  - 1 wet season rice and diversification in the dry season with 2nd crops and/or fodder species → market links, giving value to diversification process, key to be engaged under an integrated management of soil and water resources.


Example based on topographic position - Upper sandy terraces

- **Biomass inputs is key** (quantity and quality) on upper sandy terraces
- Diversification with cash crops or cover crops (→ legume fodders)

- Need for appropriate-scale machinery with roller crimper, NT planter or seed broadcaster

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



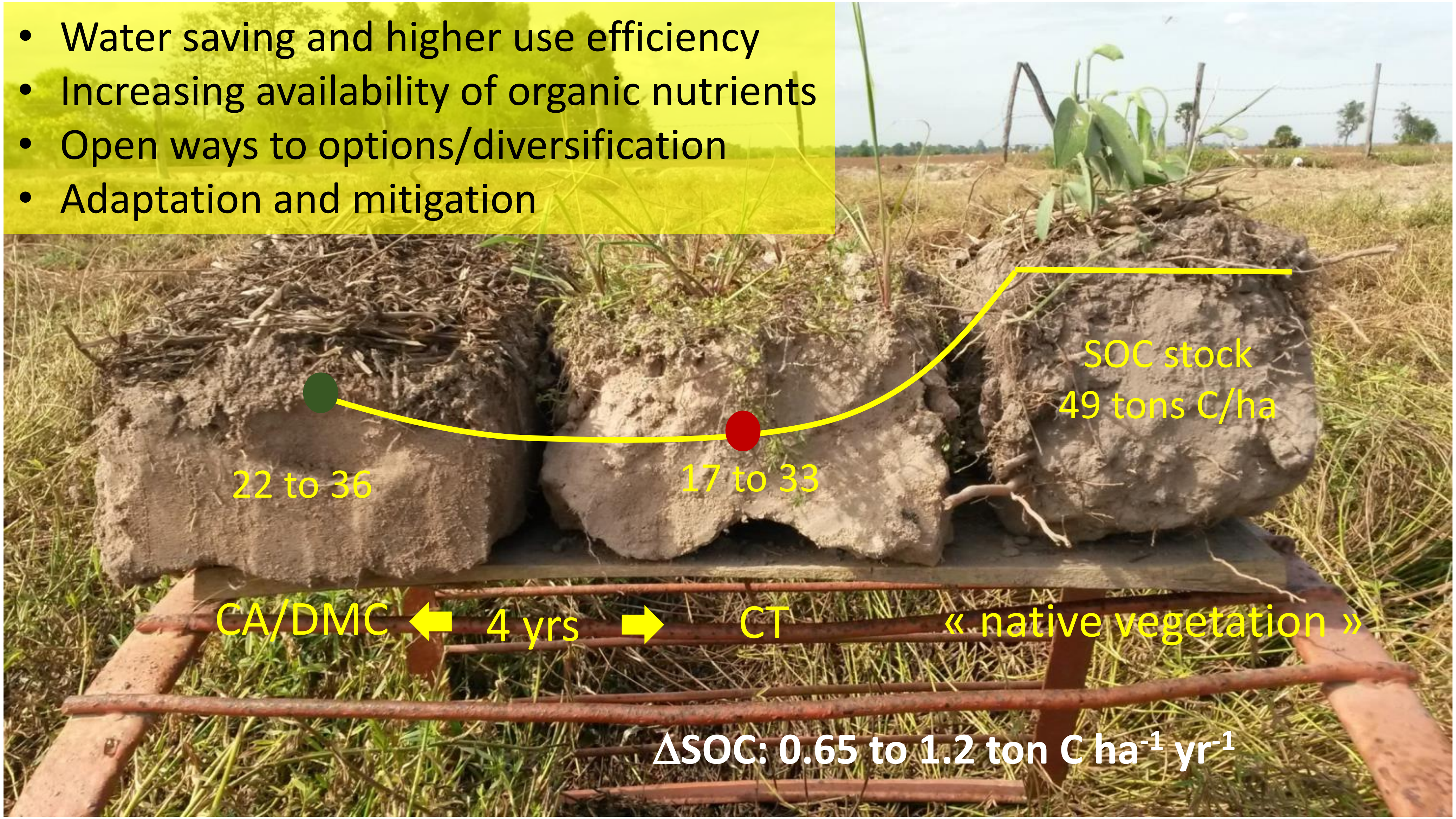

Upper position, Stung Chinit
Feb. 2017
A mix of legume


Feb. 2017
Crotalaria ochroloeuca + Centrosema on residual soil moisture


Increase in soil organic matter driving nutrient cycling, soil biological activity, water retention and adaptation to climate change
80% sand

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
- Adaptation and mitigation



MSc. Leng Vira (GDA/DALRM; Msc Tokyo University of Agriculture and Technology, CIRAD): Early changes in SOC, N, labile-C and soil microbial biomass-C under lowland rice (2014-2016)

Pkha Rumdoul direct seeded on mulch of *S. guianensis* and *C. Pascuorum*

Farmer’s fields under CA/DMC management – Stung Chinit

Farmer’s fields under CA management – Stung Chinit




Example based on topographic position – Flood plains

Development of fodder legumes on residual soil moisture in the dry season. Banan district, Battambang

Legume: soil fertility management and protein source for cattle

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

May 2016

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

Establishment of cover/relay crops after wet season rice (Battambang, Banan, 32 ha, 18hh)

- 4.5 t/ha Phka Rumdoul
- 1 wet season rice (3.8 t/ha) + ‘ratooning’ (700 kg/ha)
- Establishment of cover/fodder sp. after ratooning

Sowing rice on living cover crop, increasing efficiency

- Higher flexibility
- Reduction of production cost
- Higher input/production of biomass
- Continuous process of decomposition/mineralization during rice cycle
- Towards 0 herbicide
- Quality of the products


3 days after sowing



3.6 t/ha Phka Rumdoul
48 N – 43 P_2O_5 – 30 K_2O

Seed broadcasting on green cover crop + rolling

Rice broadcasted (dry seed) on mulch of *Centrosema pascuorum*, flood plains

Seed broadcasting on green cover crop + rolling

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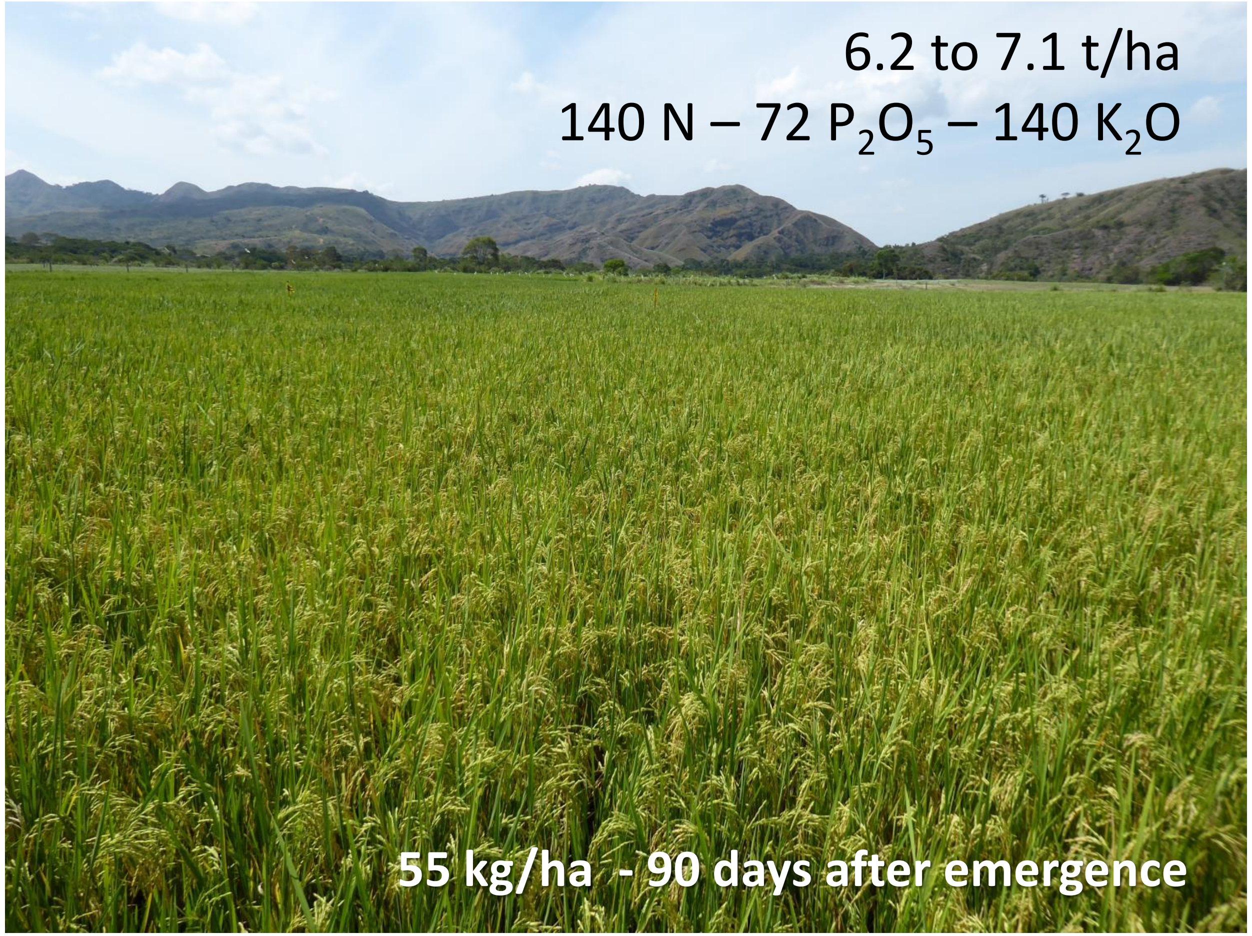
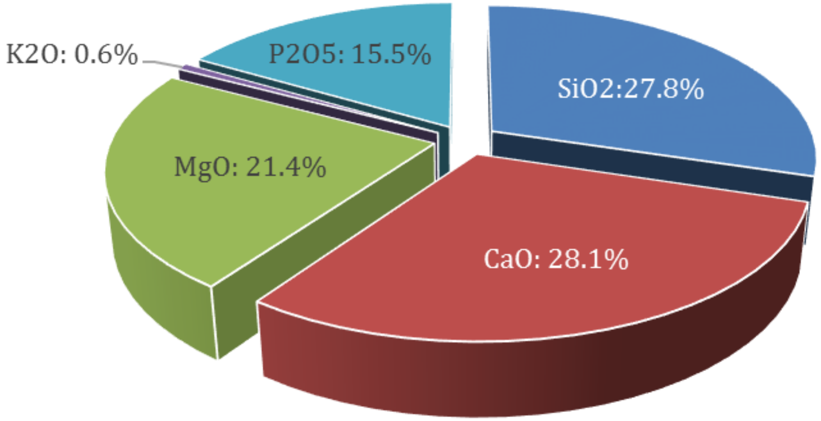


Aggregating 'simple' tools

Rice husks

- Source of Si
- Increasing plant tolerance to pests and diseases
- Composting rice husks + cow/chicken manure + thermophosphate → compressing, making pellets



Ca-FMP

Ca-Fused Magnesium Phosphate (FMP, organic source)
S (100 g/kg), Mn, Zn and others trace elements

Biocontrol

- Trichoderma, Bacillus subtilus, Beauveria bassiana, Metarhizium anisopliae …

Have to be part of a holistic approach

Few messages

- Zoning based on water resources and typology of farms/fields within an irrigation scheme.
- Paths for cropping systems improvement considering technical-socio-economic issues (markets, logistics, soil fertility, water management, social organization, etc.).
- Invest in **ecological intensification (EI)** with the ambition to move from chemically-based systems to agroecosystems based on a high biodiversity, enhancing the productivity, preventing pollution, and maximizing the flow of ecosystem services.
- Shifting to ecological intensification lead to better **quality of the products** (label/standard: SRP, organic production …).


Same principles applied for annual and perennial crops in Cambodia

Sustainable farming to sustain Cambodia’s future

Let’s talk about soil

Thanks