Soil health, no-till cropping systems and appropriate-scale machinery in Cambodia

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

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

Kong et al., forthcoming. Applied Geography
Challenges: Invest in Soil Organic C

- Less than 20 years of cultivation
- Forest
- Soil Carbon stock (%)
- Maize, cassava production (tons)
- Maize production boom
- Cassava bust
- Soil C depletion
- Erosion, runoof, oxidizing SOM, extracting nutrients, high fuel consumption...
- GHG emissions, low soil biota

Graph showing:
- Soil Carbon stock (%)
- Maize, cassava production (tons)
- Production boom
- Soil C depletion
- Forest
- Maize production boom
- Cassava bust
- 1998 to 2020 timeline
- 2010: 400,000 tons of maize
- 2005: 300,000 tons of cassava
Soil Organic C as a driver

**SOC depletion**

\[ C_{\text{input}} < C_{\text{output}} \]

- Bare soil
- Erosion, runoff

**SOC accumulation**

\[ C_{\text{input}} > C_{\text{output}} \]

- Soil protected
- Permanent flow of C

Maize under plough-based management  
Maize under CA management
Sustain healthy soils and agroecosystems

Different elements should be combined (no-tillage, permanent soil protection, diversified cropping system) …
Sustain healthy soils and agroecosystems

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

Mix of sorghum, sunnhemp, rice-bean and cowpea

Stylosanthes guianensis

Examples of cover crops – Need for genetic materials and seeds!
A range of cropping systems under CA management - Cambodia

- Rice
- Cassava
- Soybean
- 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)

NT planter, roller crimper, seed broadcaster …
CA-based rice production in the floodplains (41ha, 19hhs)

Sowing rice on green cover crop
- Higher flexibility, high efficiency
- Reduction of production cost
- Towards 0 herbicide
- Quality of the products

NT rice sowing

Rice seed broadcasting
- 1 seed broadcaster + 1 roller
- Low investment
- Low operational cost
Floodplains: CA open ways to diversification after rice ... on residual soil moisture

Generate new income, markets, transforming rural communities

Stylosanthes guianensis (legume, fodder source)  
Which value ($/ton), for which area around the Tonle Sap and which machinery?

700,000 ha of floodplains around the Tonle Sap Lake, bare soil during the dry season, free roaming cattle → production of protein and sustain soil fertility
Floodplains: CA open ways to diversification after rice ... on residual soil moisture

• Increase yield of rice of 1 ton/ha when using mix of cover crops (jasmine rice).
• High demands to use cover crops during dry season both for soil fertility management and fodder sources.
• Expected area of rice sowing + cover crops in 2018: >100 ha (lack of NT planters)
For annual upland crops: maize, cassava...

Farmer network, 2017: 265 ha, 94hhs (only 2 planters operating)
Service: $40/ha for NT sowing
$490/ha net profit for maize; +200$/ha when compared with CT
CA is also about seed production and sharing: example of sunnhemp

Farmers shared/purchased seed of juncea with seed producers and established juncea early March as a cover crop before maize (on area going from 1 to 10 ha)
Early CA maize

5 to 9t/ha

Mix of cover crops after early maize that will cross the dry season (15 to 20 t DM/ha)

CA Cassava

25 to 35 t/ha

No plough, no ridge

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
A long term effort to show benefits to producers, policymakers …

- What about the value of 1 t of soil organic C: \( \text{H}_2\text{O}, \text{nutrients, O}_2 \text{ flow, structure} \ldots \)
- Environmental, economic and social values?
A long term effort and a collective investment:
- GDA: DALRM, DAEng
- RUA, CESAIN, SILL, CIRAD
- USAID, AFD, CCCA

Cropping system design, germplasm, soil health assessment, machinery
Scientific recognition
Building a national training centre on Conservation Agriculture and germplasm preservation/sharing
Using CA combined with plant biodiversity to increase soil fertility and water-use efficiency (experiments and on-farms):

- Increasing soil C from 500 to 1200 kg/ha/year in upland and rice farming.
- Increasing nutrients cycling, soil biota.
- Up to two times water infiltration avoiding runoff, soil erosion and retaining more water in fields.

Hok et al., 2015, AEE; Hok et al., 2018, STR; Ngoc Le et al., 2018, AEE; Leng et al., forthcoming; Pheap et al., forthcoming
It’s time to scale-up!

- Availability (and affordability) of NT planter.
- Involvement of medium-entrepreneurs, service providers (skills).
- Explore mechanisms (PPP) to support a transition from plough-based to CA management.
It’s time to scale-up!

- Policy, implementation and financial mechanism.
- Make CA an integral part of the agenda: (i) to build resilient farming, (ii) to fulfill obligations related to climate change.
- Farm’s profitability, attract youth in agriculture, food safety.
- **Identifying the entry point**: example of policy in India to avoid rice straw burning through the combination of straw management system with the Turbo happy seeder (availability, skills).
Advocacy, advertise

Sustainable farming to sustain Cambodia’s future

https://vimeo.com/121032329

Thanks
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